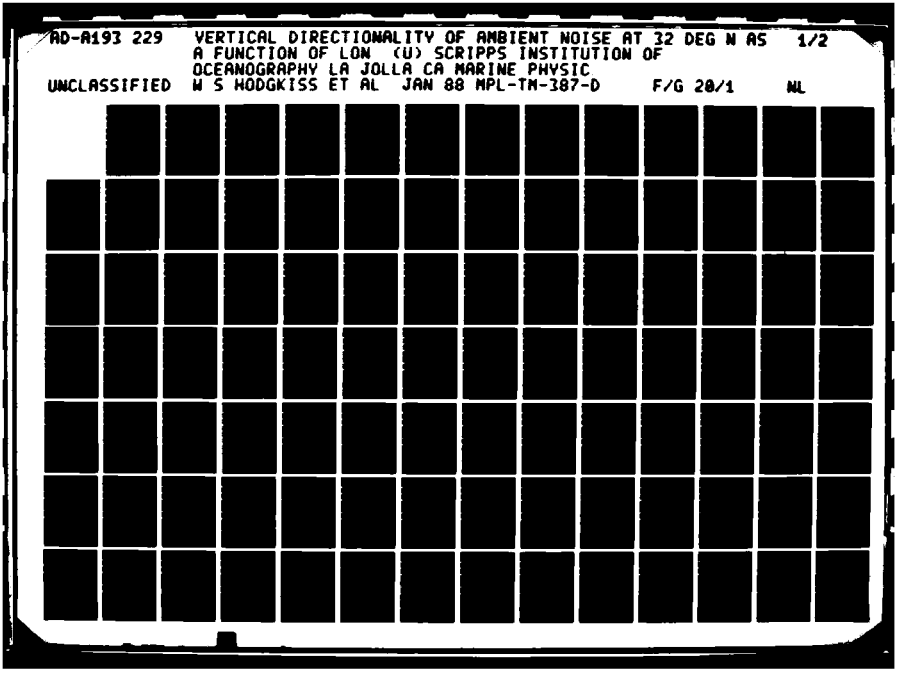
AD-A193 229 VERTICAL DIRECTIONALITY OF AMBIENT NOISE AT 32 DEG N AS 1/2
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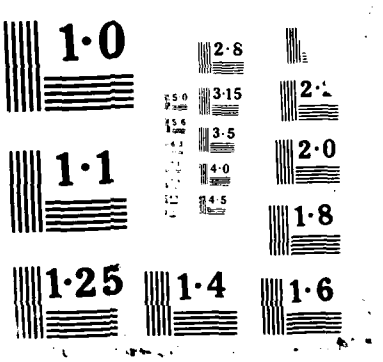
UNCLASSIFIED W S HODGKISS ET AL JAN 88 MPL-TM-387-D F/G 20/1 NL


1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·5
3·15
3·5
4·0
4·5

MARINE PHYSICAL LABORATORY

SCRIPPS INSTITUTION OF OCEANOGRAPHY

San Diego, California 92152

VERTICAL DIRECTIONALITY OF AMBIENT NOISE AT 32 ° N AS A FUNCTION OF LONGITUDE: Tape #86247

W. S. Hodgkiss and F. H. Fisher

MPL TECHNICAL MEMORANDUM 387-D

MPL-U-32/86

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January 1988

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Measurements have been made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32°N (124°W, 136°W, and 150°W). This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32°N, 136°W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.

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Vertical Directionality of Ambient Noise at 32 ° N as a Function of Longitude: Tape #86247

W.S. Hodgkiss and F.H. Fisher

Marine Physical Laboratory
Scripps Institution of Oceanography
San Diego, CA 92152

Abstract

Measurements have been made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32 ° N (124 ° W, 136 ° W, and 150 ° W). This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32 ° N, 136 ° W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.

I. Introduction

This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86247. The tape was recorded at 32 ° N, 136 ° W (approximately 1000 nmi due west of San Diego) on 9 May 1986 beginning at 13:38 PDT. At that time, the wind speed was 17 kts.

A complete description of the experiment and data analysis procedure is given in the summary technical report (TM-387-A). Here, a brief guide will be provided to the results documented in the the various sections.

Section II (Preliminary Analysis) provides a preliminary look at the data quality from 4 hydrophones spaced approximately equally across the array for the first data segment (65536 points). The results are ordered as follows:

(1) Channel means (A/D counts).

(2) Time series (A/D counts) for the first 1024 points of the first segment.

(3) Time-varying mean (A/D counts, 64-point averages).

(4) Time-varying power (A/D counts squared, 64-point averages) (channel means have been removed).

(5) Power spectra (dB//μPa/$\sqrt{\text{Hz}}$) (channel means have been removed).

Section III (Power Spectra) provides an extended preliminary look at the power spectra from all hydrophones in the array for the first data segment (65536 points). The results are ordered as follows:

(1) Channel means (A/D counts).

(2) Power spectra (dB//μPa/$\sqrt{\text{Hz}}$) (channel means have been removed).

Section IV (Array Response: Waterfall, KB Window) provides waterfall plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB//μPa/$\sqrt{\text{Hz}}$Deg). A Kaiser-Bessel window ($\alpha = 1.5$) was used to amplitude shade the array elements.

Section V (Array Response: Waterfall, Rect Window) provides waterfall plots of the time-evolving

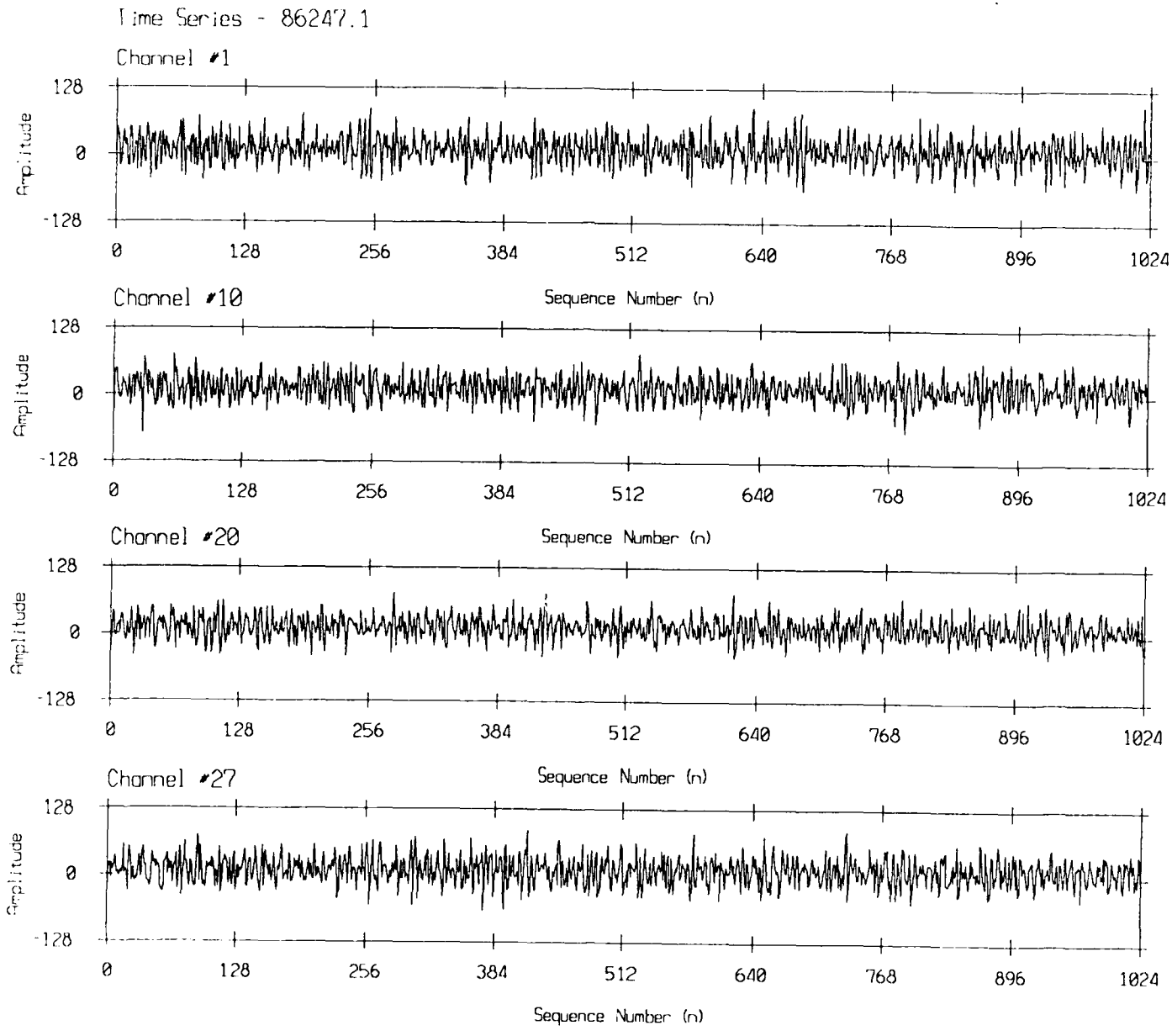
vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB//μPa/$\sqrt{}$HzDeg). A rectangular window was used to amplitude shade the array elements.

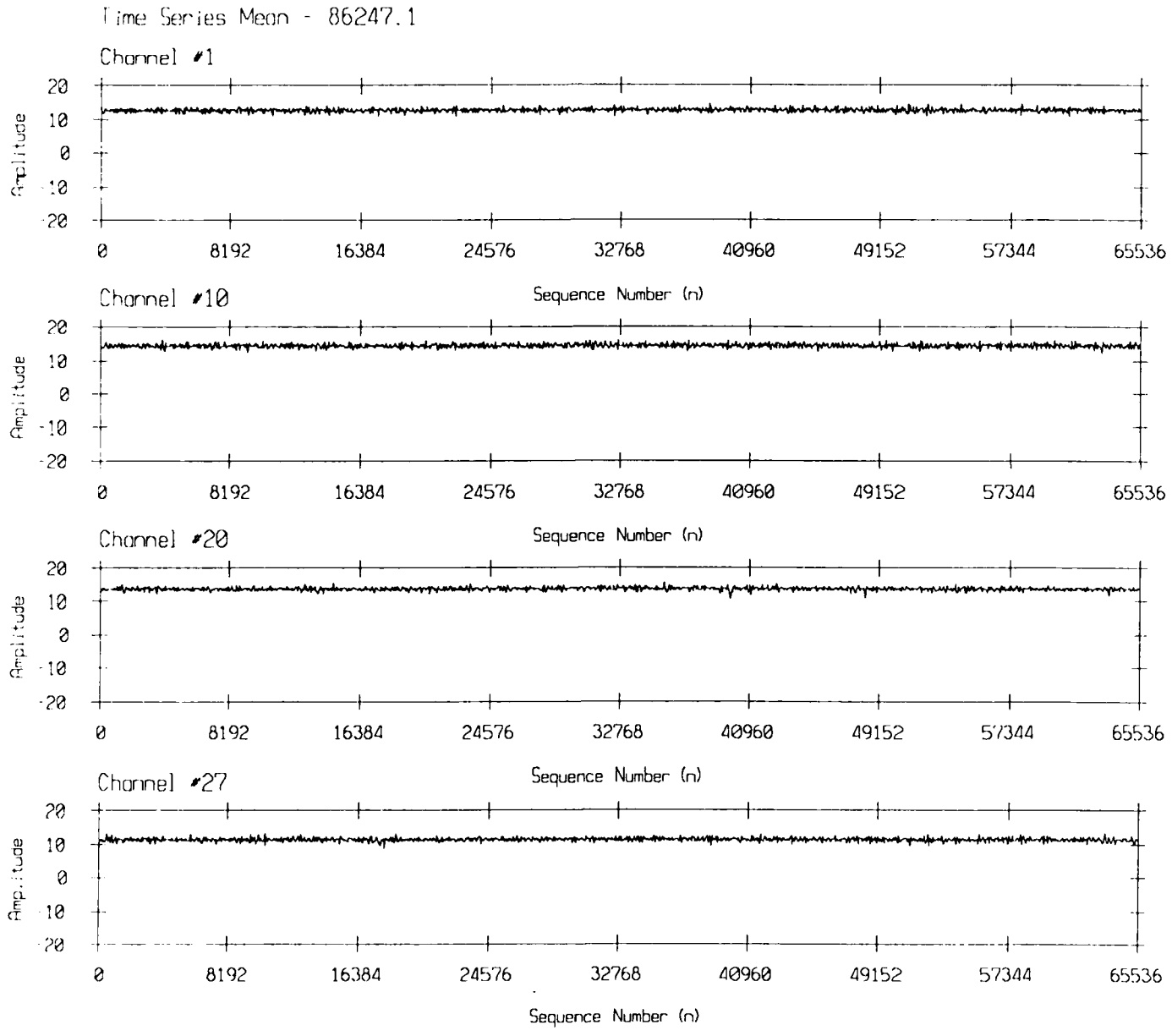
Section VI (Array Response: Panels, KB Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB//μPa/$\sqrt{}$HzDeg). A Kaiser-Bessel window ($\alpha = 1.5$) was used to amplitude shade the array elements.

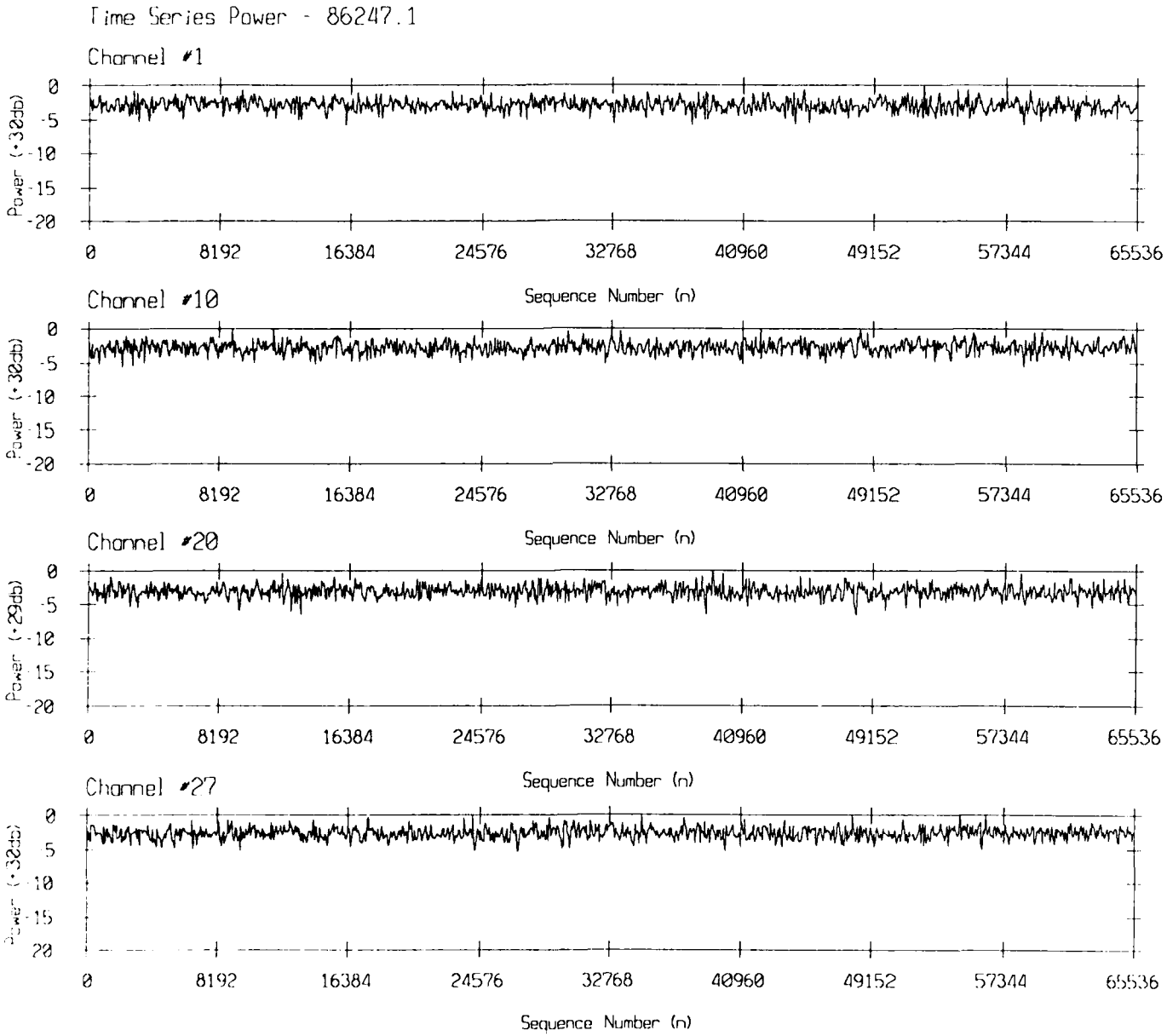
Section VII (Array Response: Panels, Rect Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB//μPa/$\sqrt{}$HzDeg). A rectangular window was used to amplitude shade the array elements.

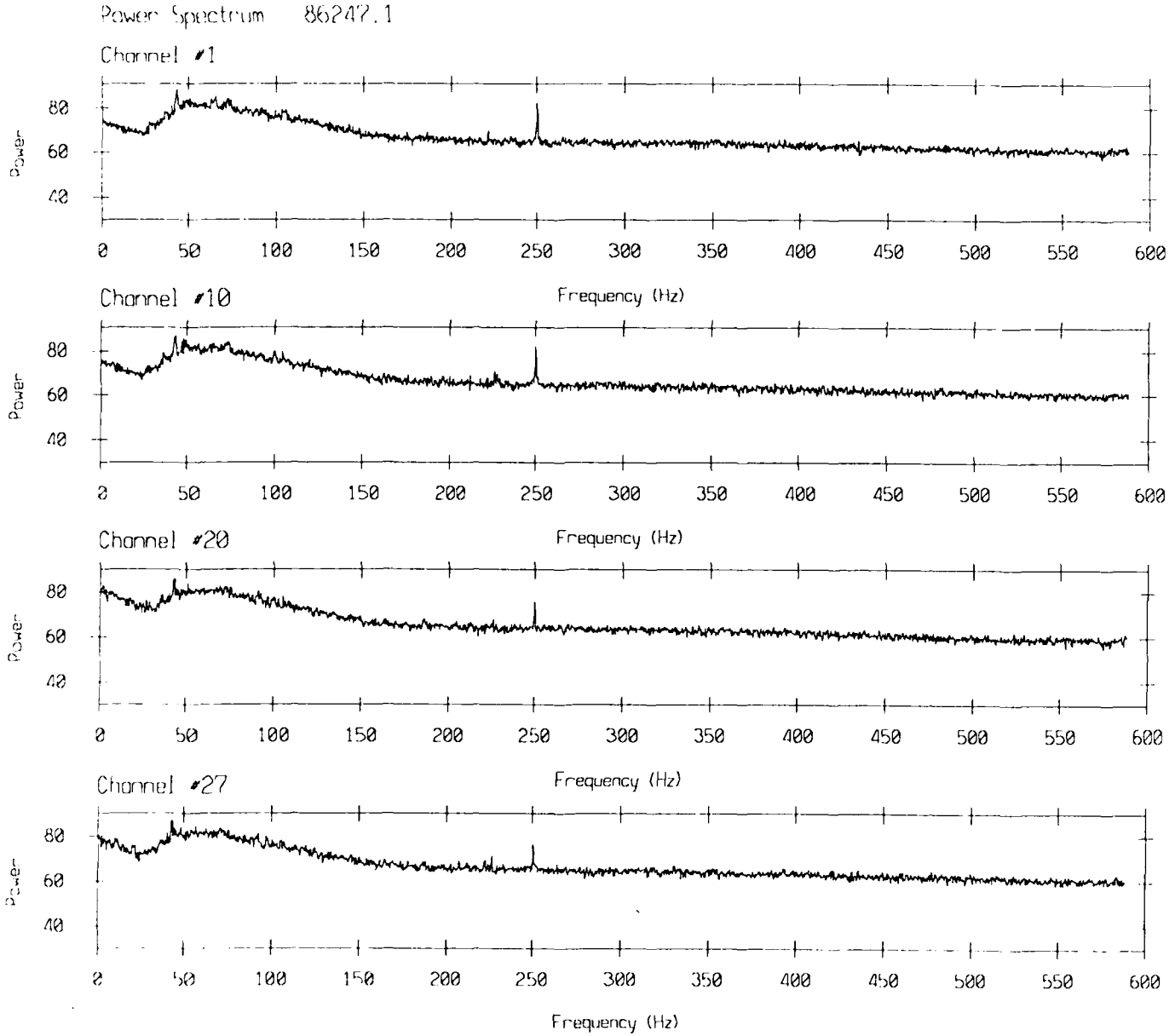
II. Preliminary Analysis.

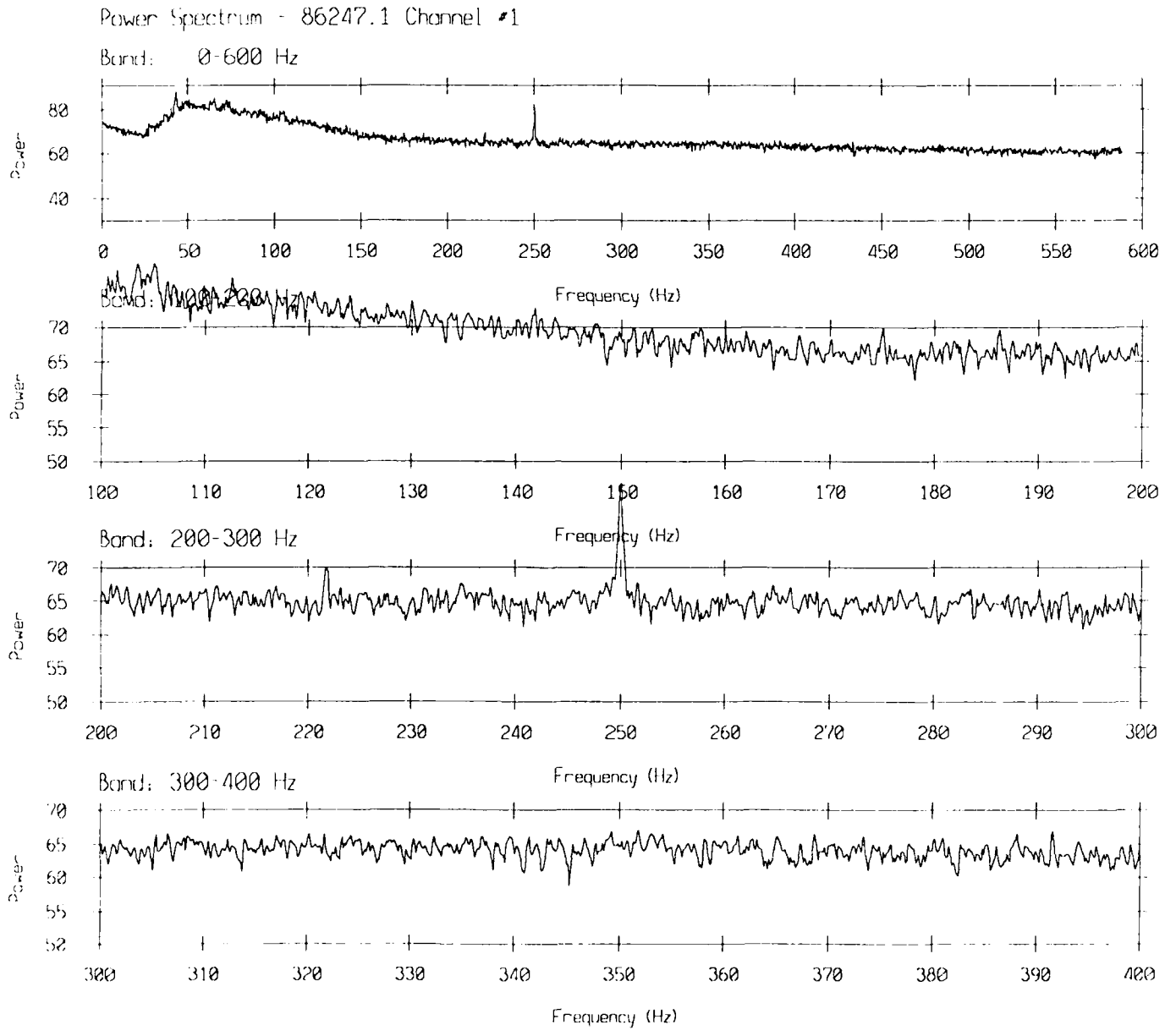
```
Channel #1
   1    12.824172973633
Channel #10
   1    14.550003051758
Channel #20
   1    13.785659790039
Channel #27
   1    11.292495727539
```

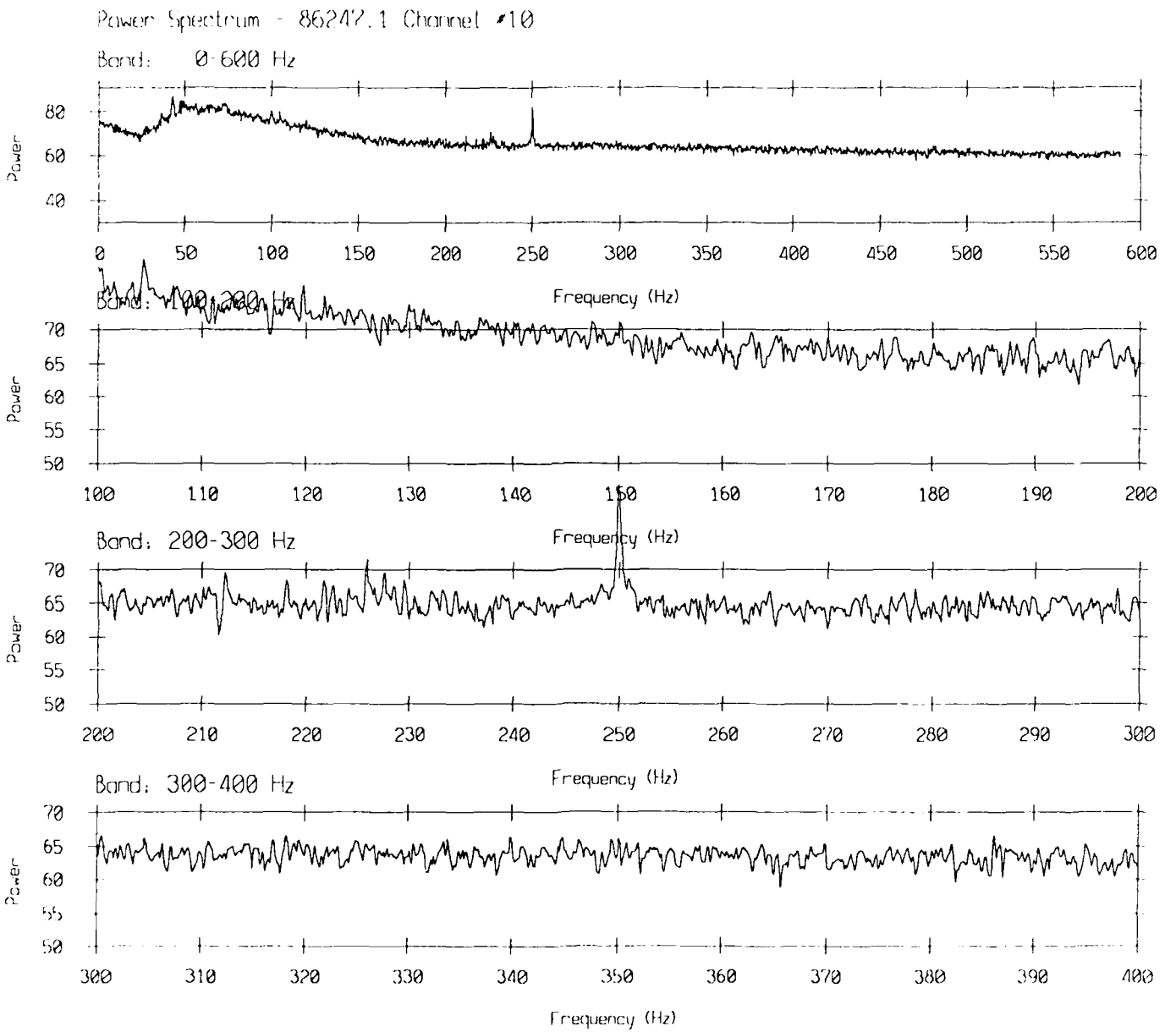

Time Series - 86247.1
Channel #1
Channel #10
Channel #20
Channel #27
Amplitude
128
0
-128
0
128
256
384
512
640
768
896
1024
Sequence Number (n)

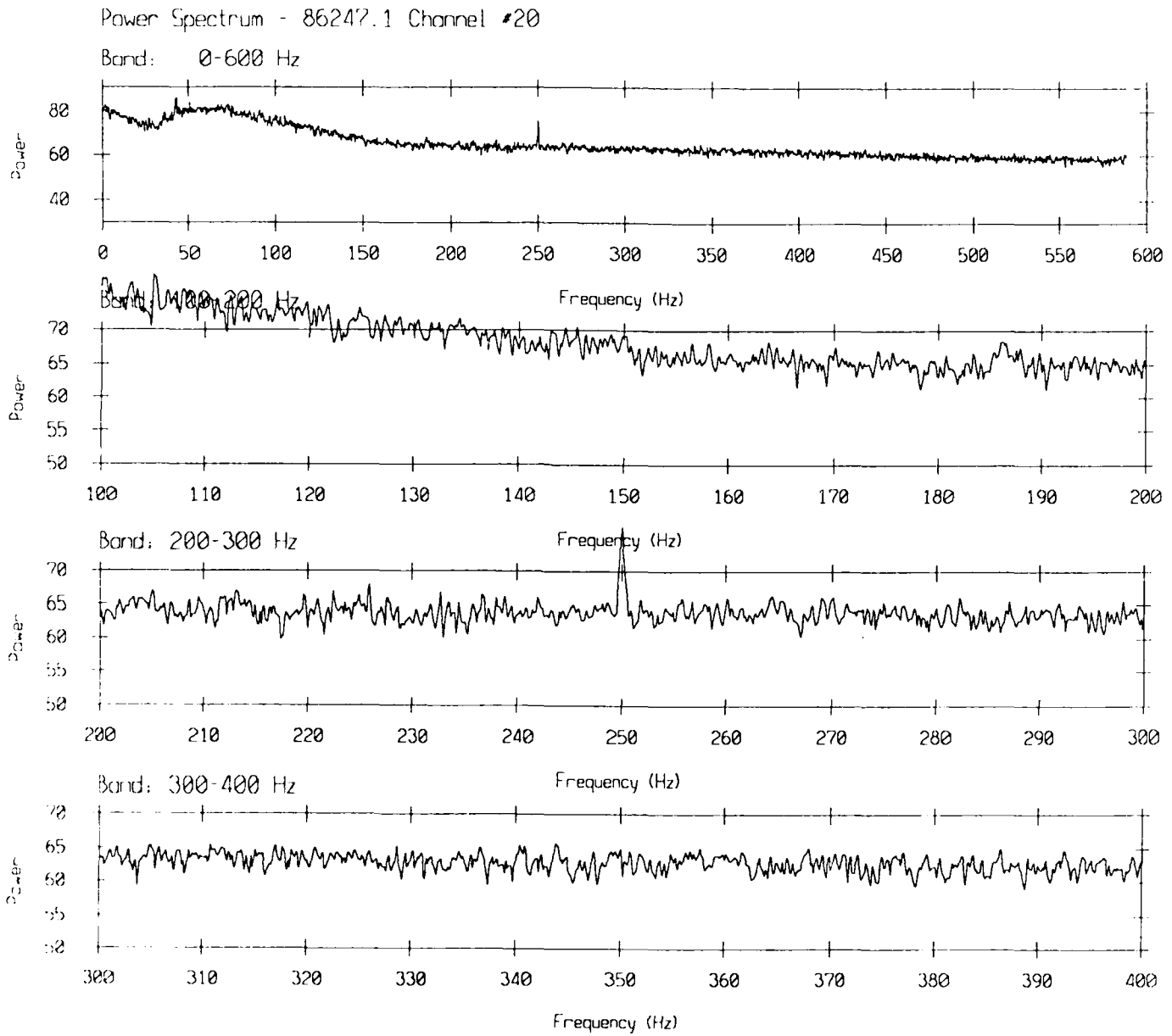

Time Series Mean - 86247.1
Channel #1
Channel #10
Channel #20
Channel #27
Amplitude
20
10
0
-10
-20
0
8192
16384
24576
32768
40960
49152
57344
65536
Sequence Number (n)

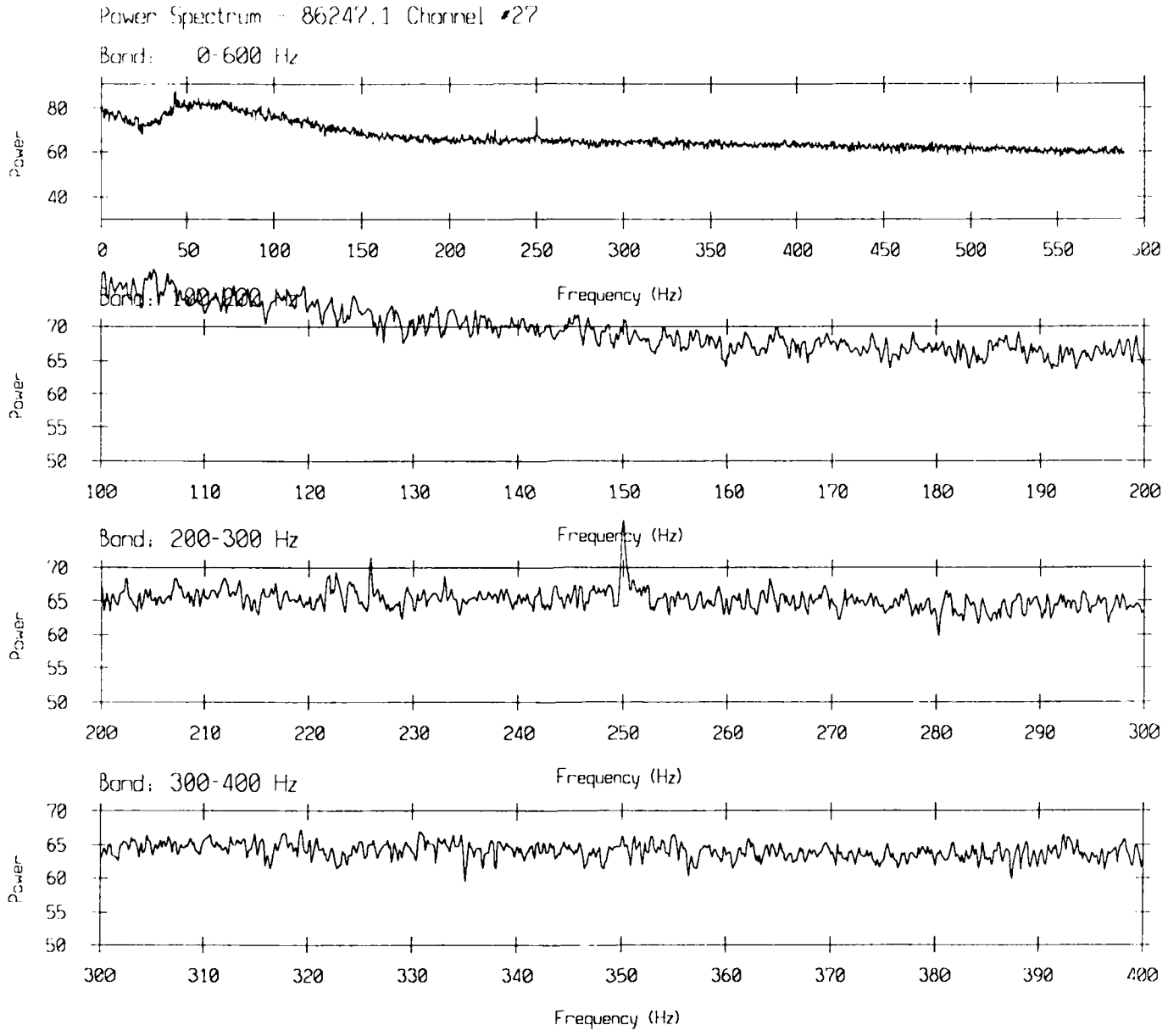

Time Series Power - 86247.1
Channel #1
Power (*32db)
0
-5
-10
-15
-20
0
8192
16384
24576
32768
40960
49152
57344
65536
Sequence Number (n)
Channel #10
Power (*32db)
Sequence Number (n)
Channel #20
Power (*29db)
Sequence Number (n)
Channel #27
Power (*32db)
Sequence Number (n)


Power Spectrum 86247.1
Channel #1
Channel #10
Channel #20
Channel #27
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)


Power Spectrum - 86247.1 Channel #1
Band: 0-600 Hz
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)
Band: 100-200 Hz
Power
70
65
60
55
50
100
110
120
130
140
150
160
170
180
190
200
Frequency (Hz)
Band: 200-300 Hz
Power
70
65
60
55
50
200
210
220
230
240
250
260
270
280
290
300
Frequency (Hz)
Band: 300-400 Hz
Power
70
65
60
55
52
300
310
320
330
340
350
360
370
380
390
400
Frequency (Hz)

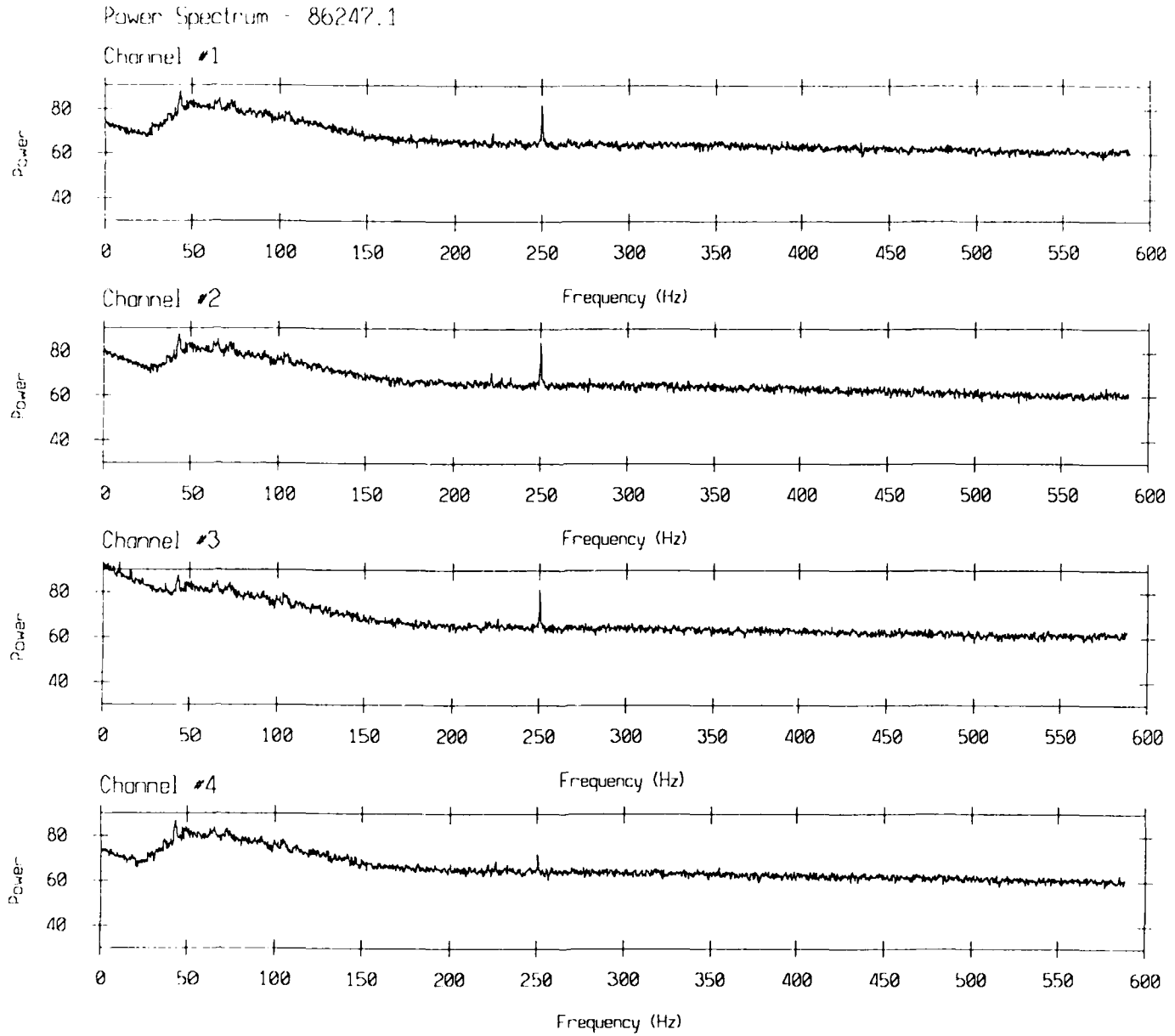

Power Spectrum - 86247.1 Channel #10
Band: 0-600 Hz
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)
Band: 100-200 Hz
Power
70
65
60
55
50
100
110
120
130
140
150
160
170
180
190
200
Frequency (Hz)
Band: 200-300 Hz
Power
70
65
60
55
50
200
210
220
230
240
250
260
270
280
290
300
Frequency (Hz)
Band: 300-400 Hz
Power
70
65
60
55
50
300
310
320
330
340
350
360
370
380
390
400
Frequency (Hz)

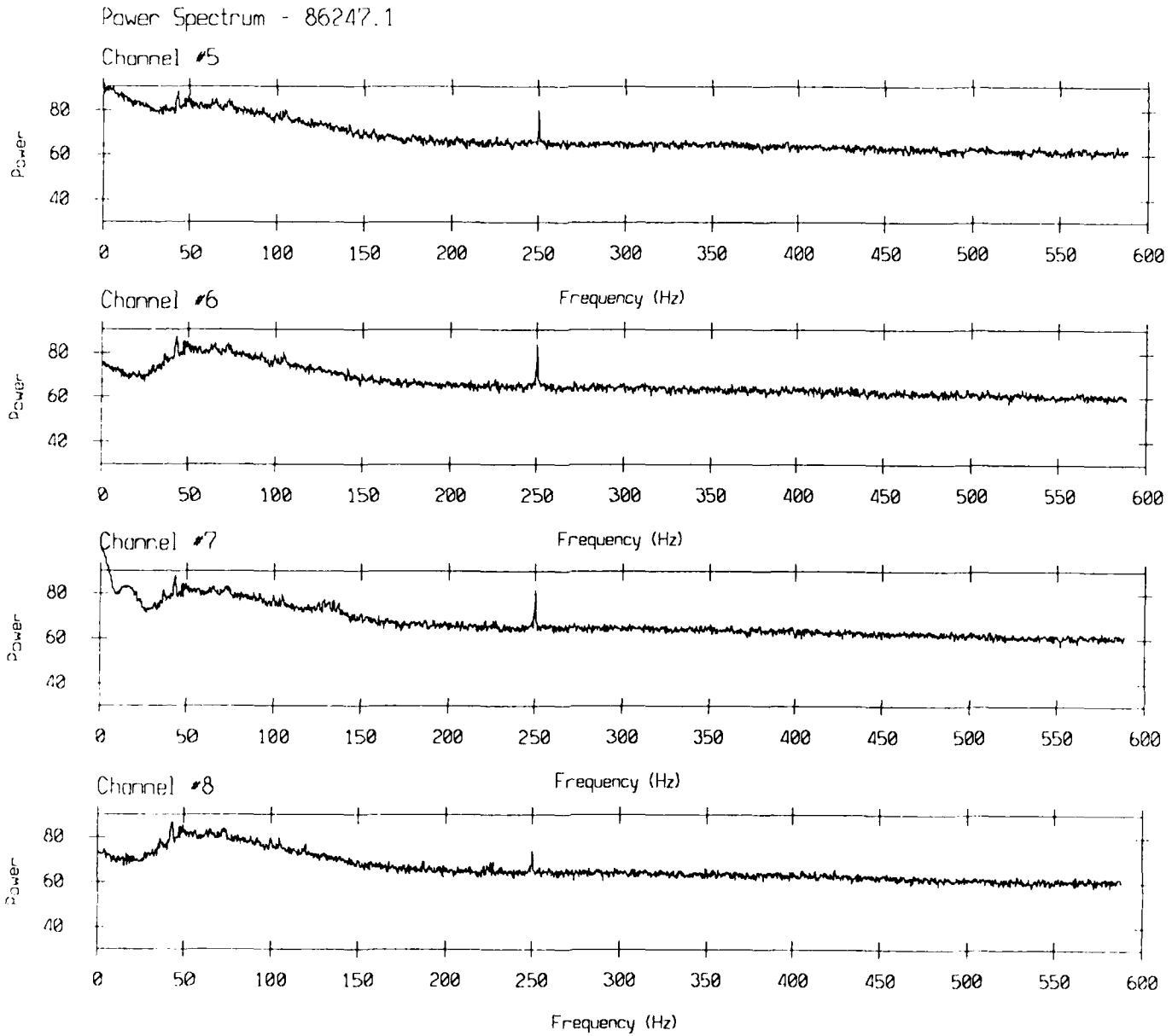

Power Spectrum - 86247.1 Channel #20
Band: 0-600 Hz
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)
Band: 100-200 Hz
Power
70
65
60
55
50
100
110
120
130
140
150
160
170
180
190
200
Frequency (Hz)
Band: 200-300 Hz
Power
70
65
60
55
50
200
210
220
230
240
250
260
270
280
290
300
Frequency (Hz)
Band: 300-400 Hz
Power
65
60
55
50
300
310
320
330
340
350
360
370
380
390
400
Frequency (Hz)

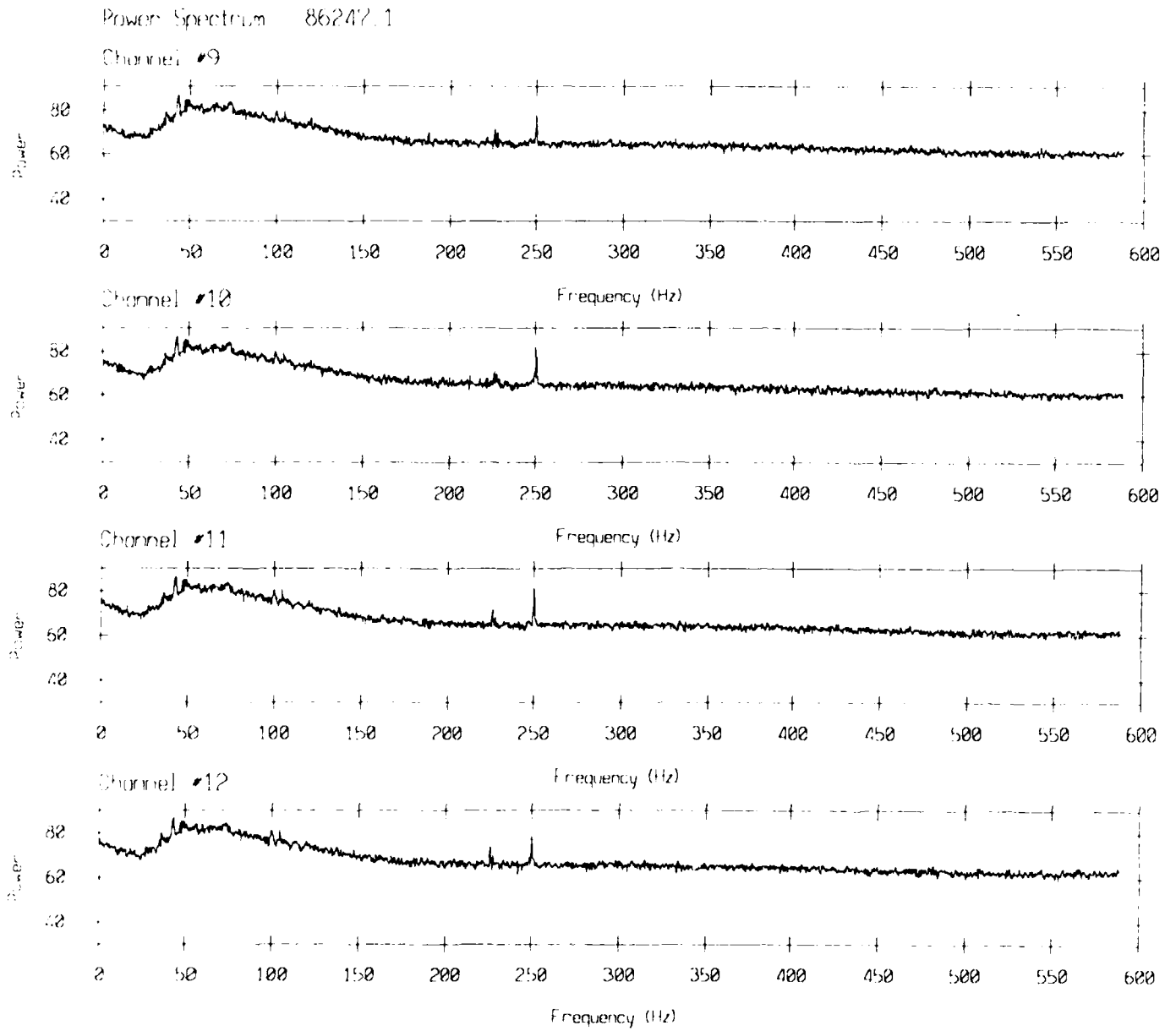

Power Spectrum - 86247.1 Channel #27
Band: 0-600 Hz
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
Frequency (Hz)
Band: 100-200 Hz
70
65
60
55
50
100
110
120
130
140
150
160
170
180
190
200
Band: 200-300 Hz
210
220
230
240
250
260
270
280
290
300
Band: 300-400 Hz
310
320
330
340
350
360
370
380
390
400

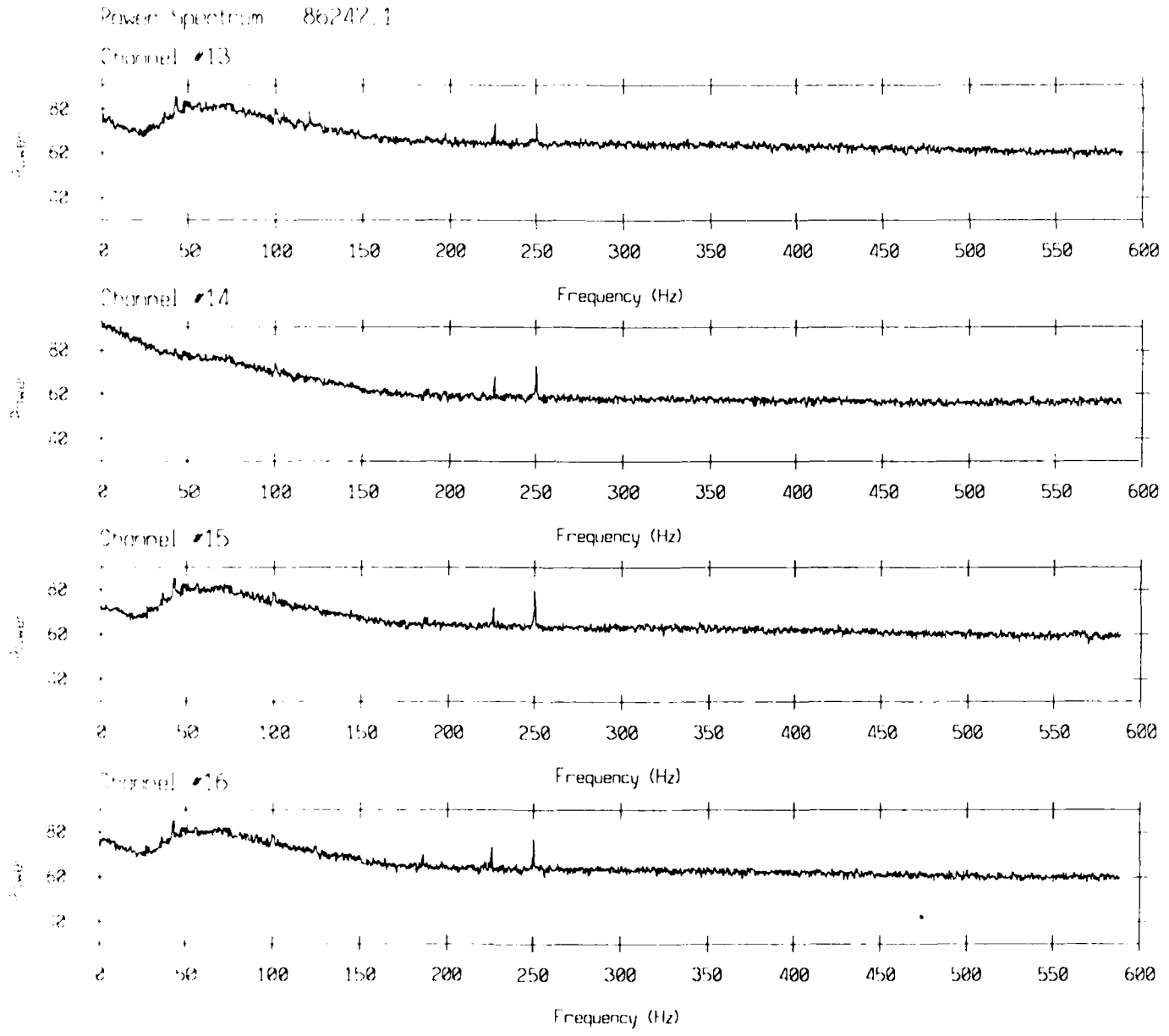
III. Power Spectra.

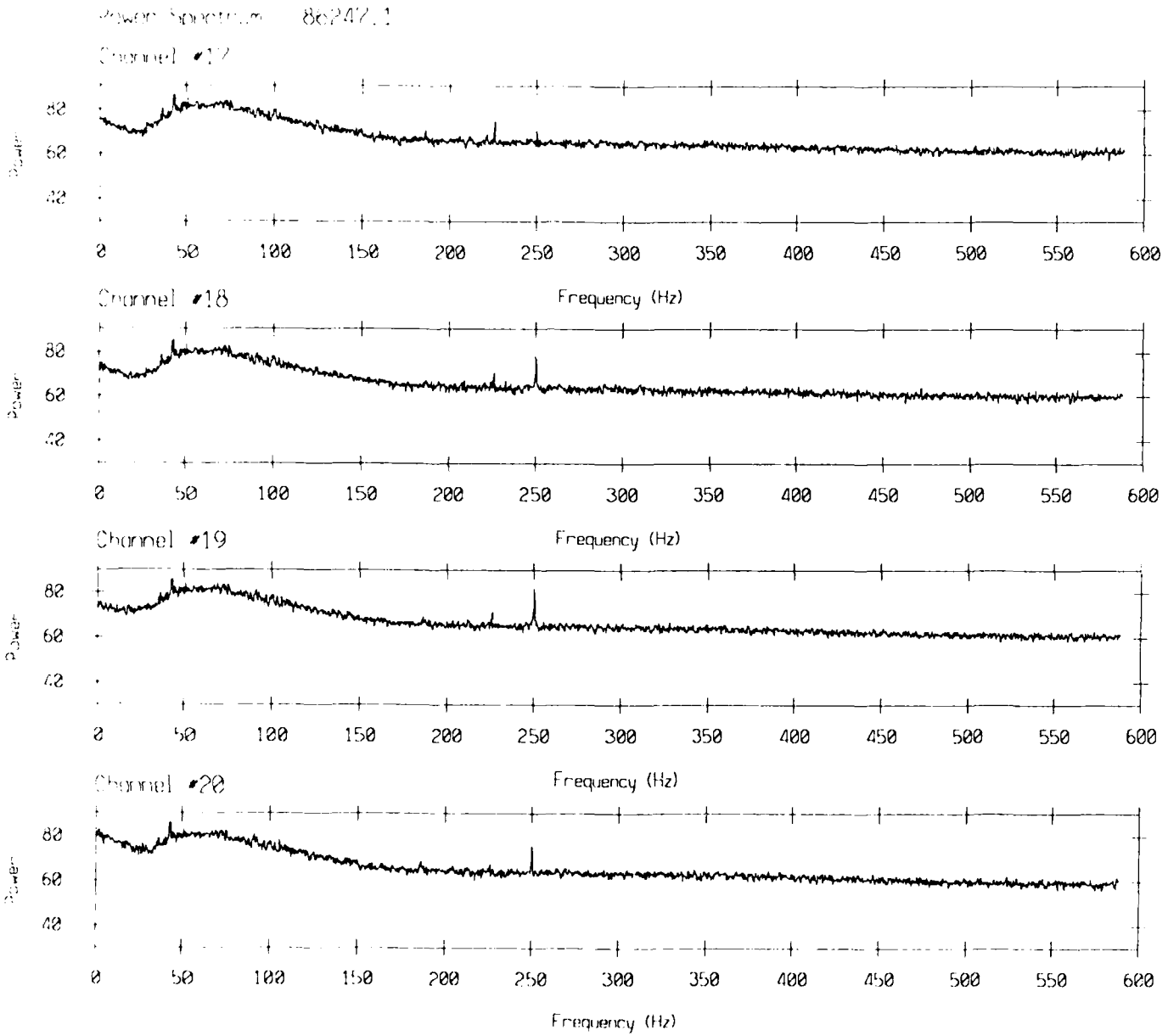
```
Channel #1
  1    12.824172973633
Channel #2
  1    11.493545532227
Channel #3
  1    11.775604248047
Channel #4
  1    10.923919677734
Channel #5
  1    12.685028076172
Channel #6
  1    9.8765258789063
Channel #7
  1    14.683319091797
Channel #8
  1    14.880233764648
Channel #9
  1    6.4552917480469
Channel #10
  1    14.550003051758
Channel #11
  1    10.507217407227
Channel #12
  1    14.164978027344
Channel #13
  1    11.610366821289
Channel #14
  1    13.031692504883
Channel #15
  1    12.402618408203
Channel #16
  1    8.7594299316406
Channel #17
  1    13.096221923828
Channel #18
  1    12.802536010742
Channel #19
  1    11.207031250000
Channel #20
  1    13.785659790039
Channel #21
  1    13.296005249023
Channel #22
  1   -128.00000000000
Channel #23
  1   -2.2585906982422
Channel #24
  1    11.410079956055
Channel #25
  1    13.596328735352
Channel #26
  1    14.124771118164
Channel #27
  1    11.292495727539
```

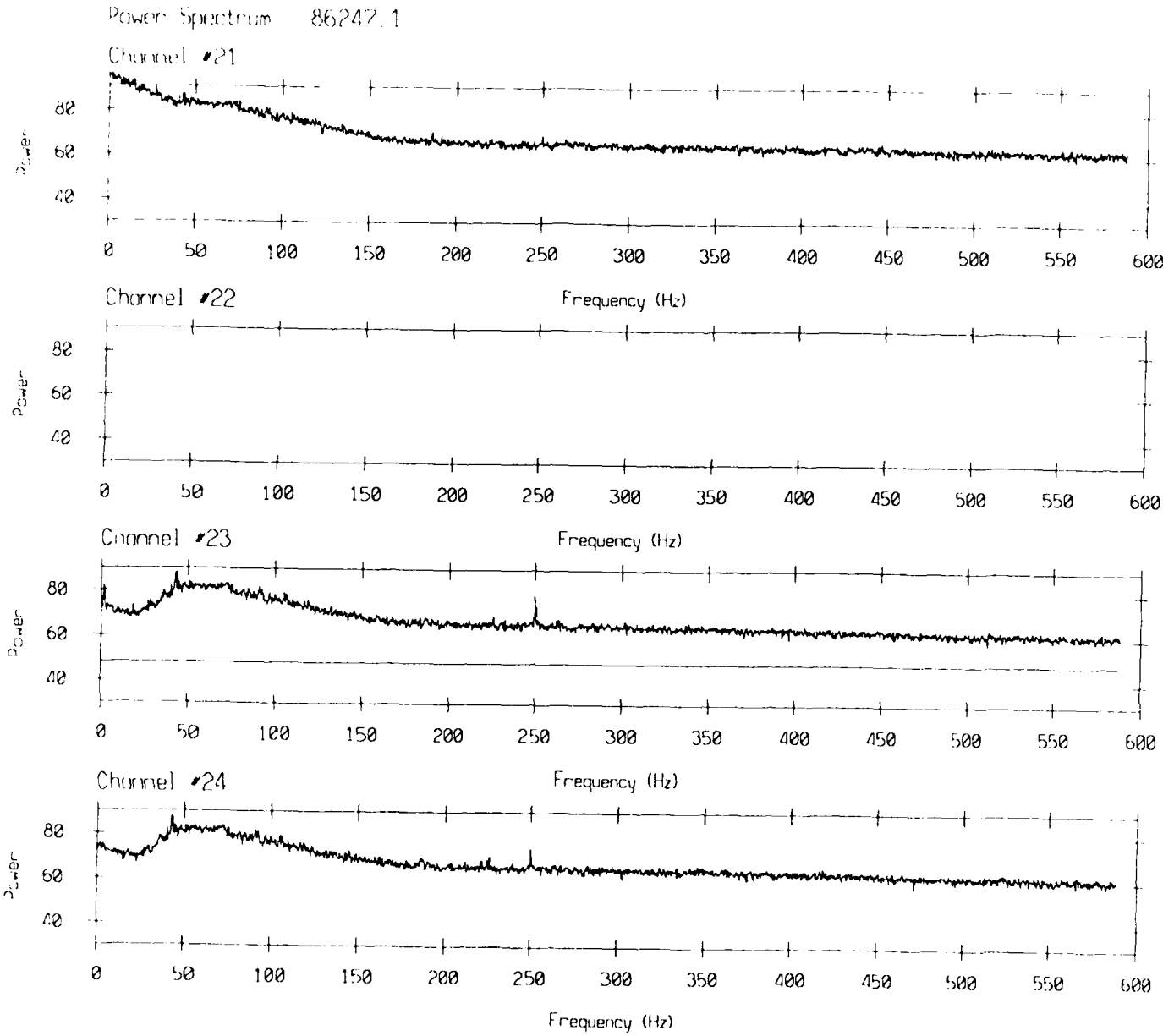

Power Spectrum - 86247.1
Channel #1
Channel #2
Channel #3
Channel #4
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

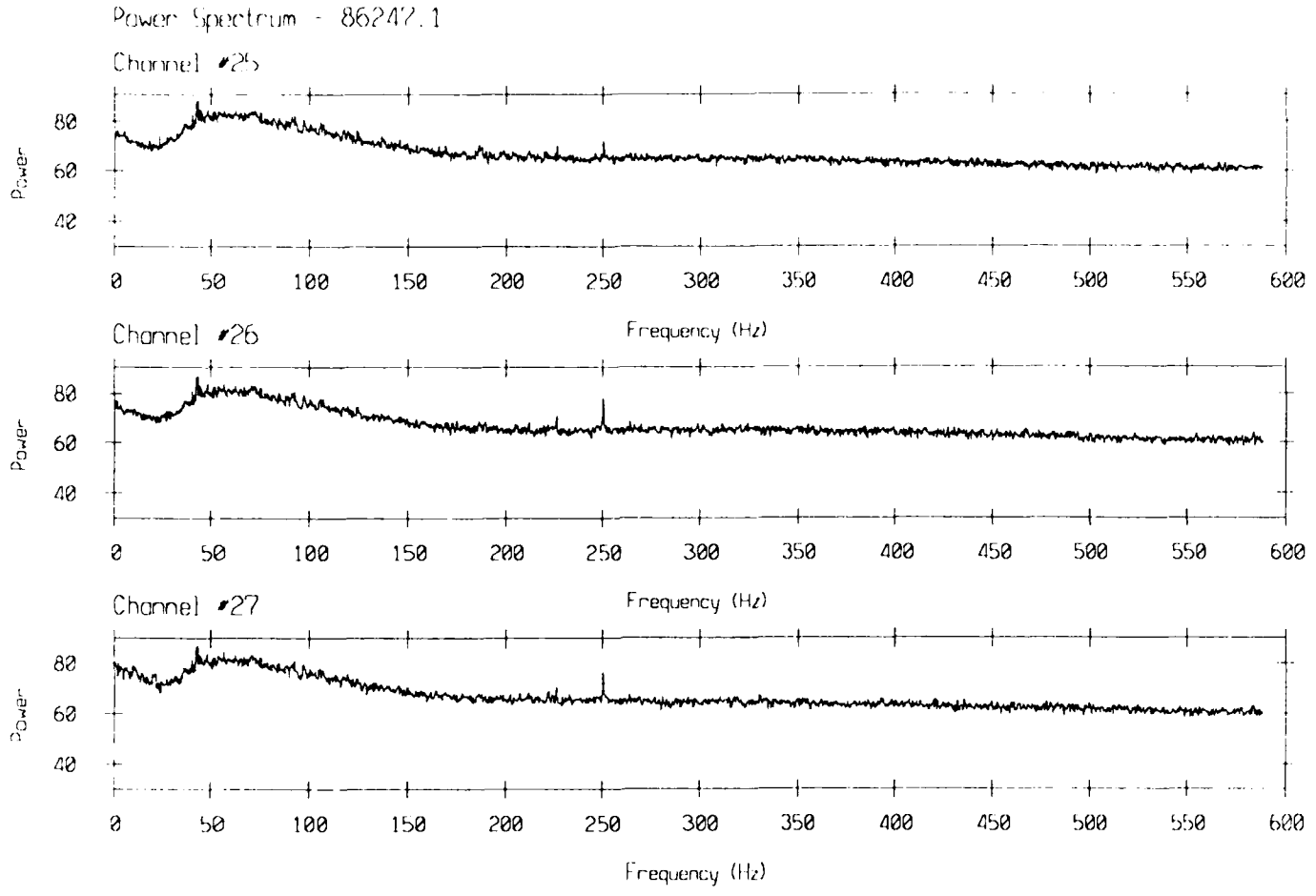

Power Spectrum - 86247.1
Channel #5
Channel #6
Channel #7
Channel #8
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)


Power Spectrum 86247.1
Channel #9
Channel #10
Channel #11
Channel #12
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

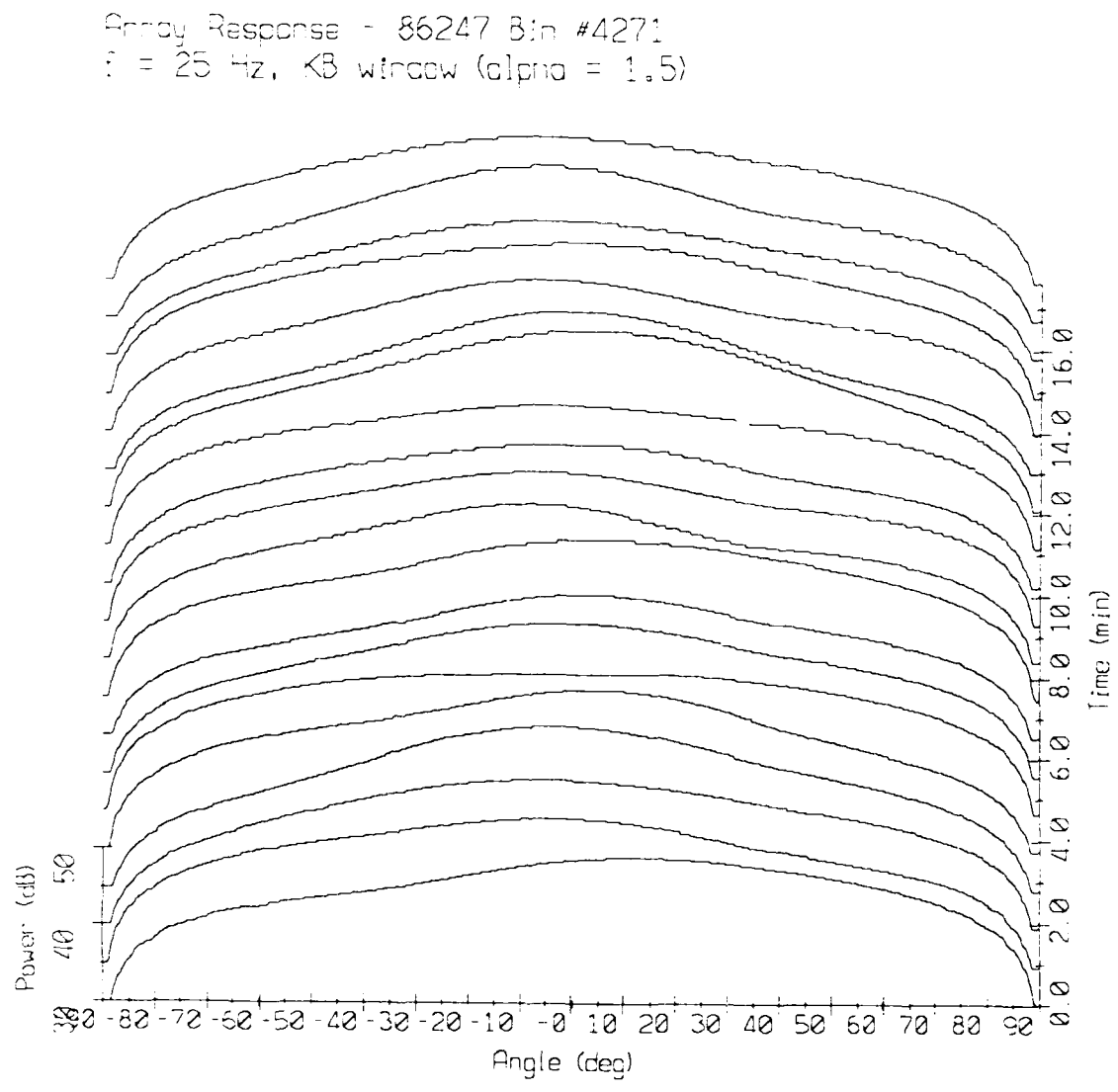

Power Spectrum 862A72.1
Channel #13
Channel #14
Channel #15
Channel #16
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

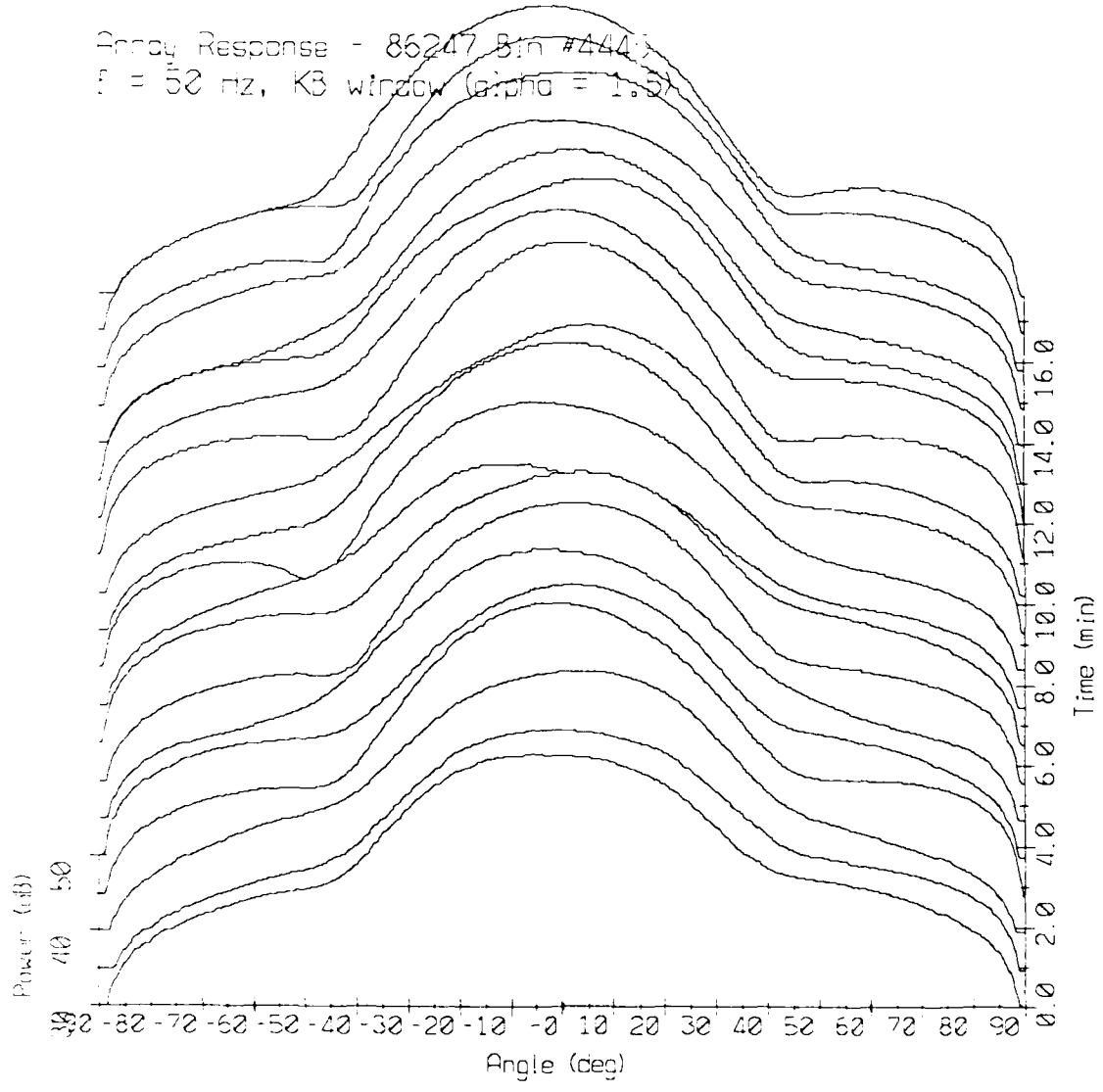

Power Spectrum 86247.1
Channel #17
Channel #18
Channel #19
Channel #20
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

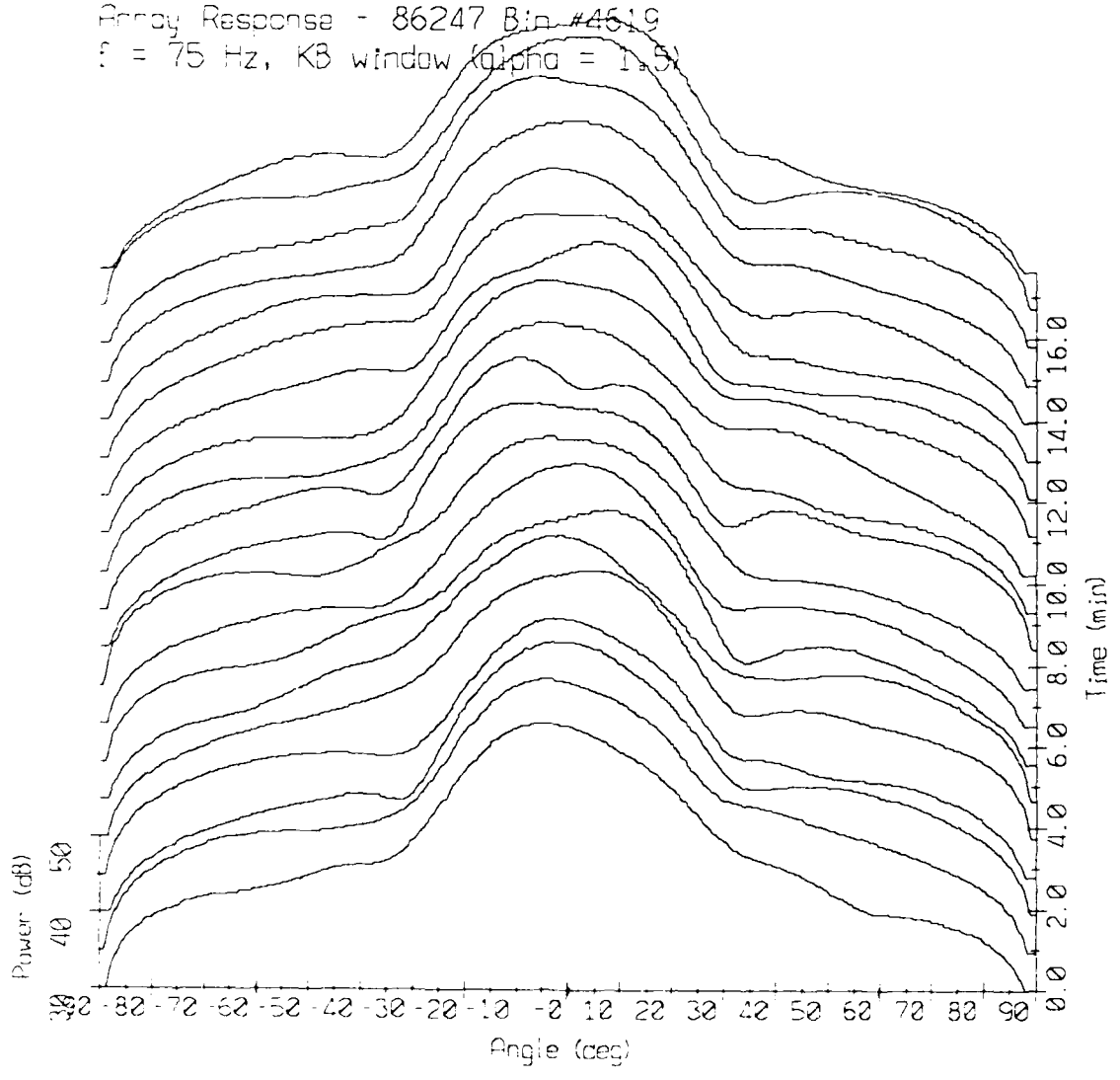

Power Spectrum 86242.1
Channel #21
Channel #22
Channel #23
Channel #24
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

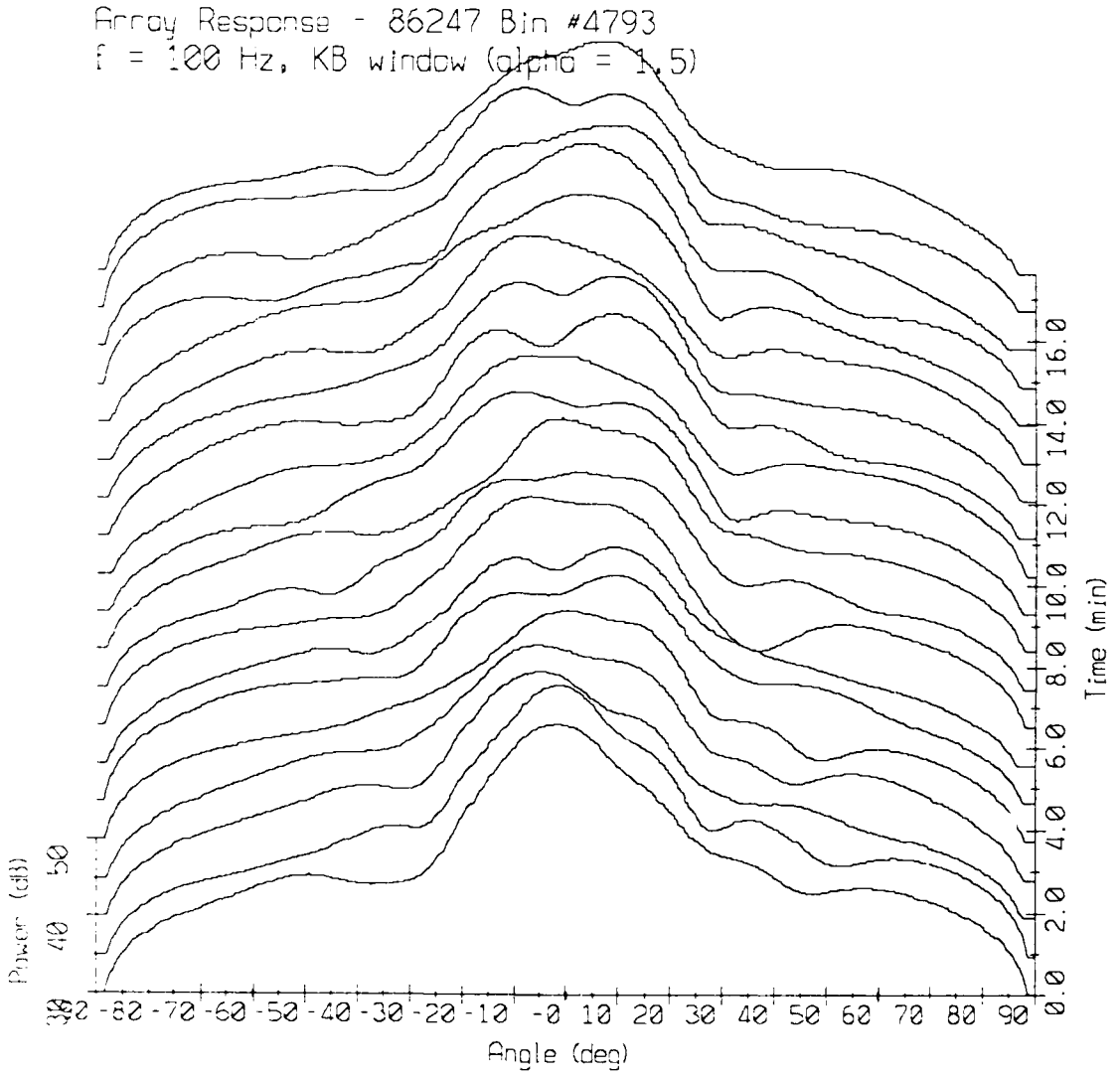

Power Spectrum - 86247.1
Channel #25
Channel #26
Channel #27
Power
80
60
40
0
50
100
150
200
250
300
350
400
450
500
550
600
Frequency (Hz)

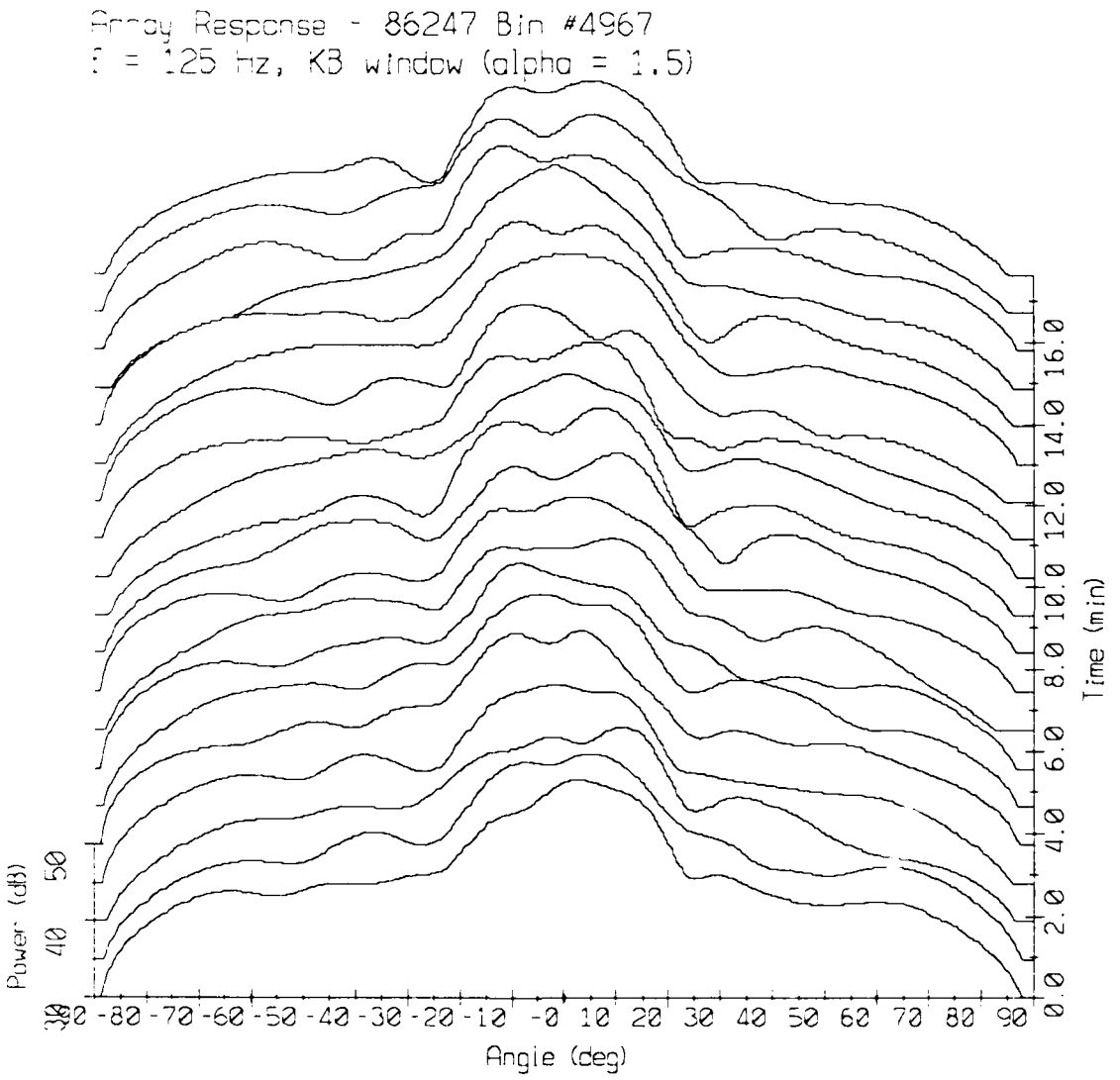
IV. Array Response: Waterfall, KB Window.

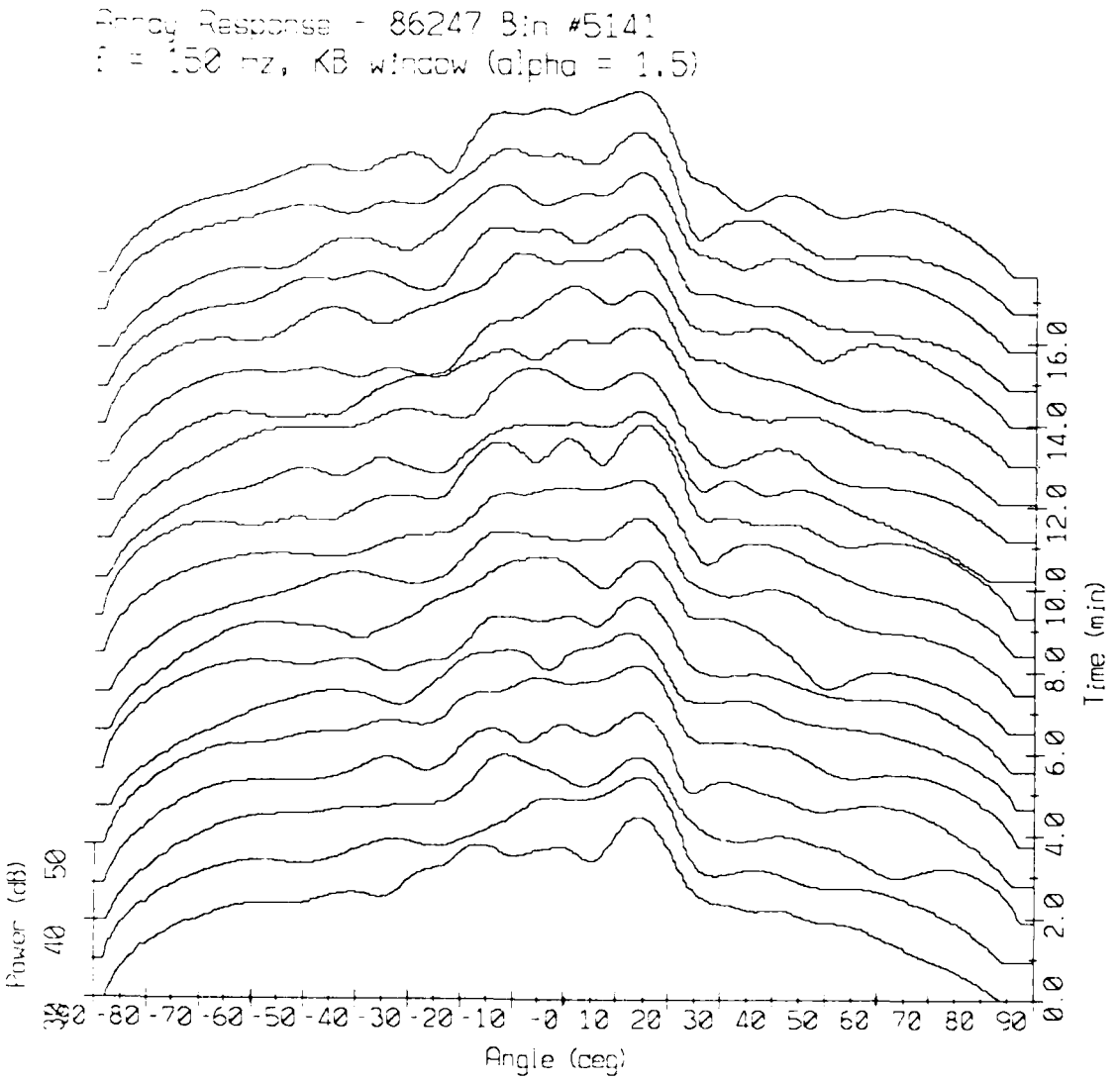

Array Response - 86247 Bin #4271
f = 25 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

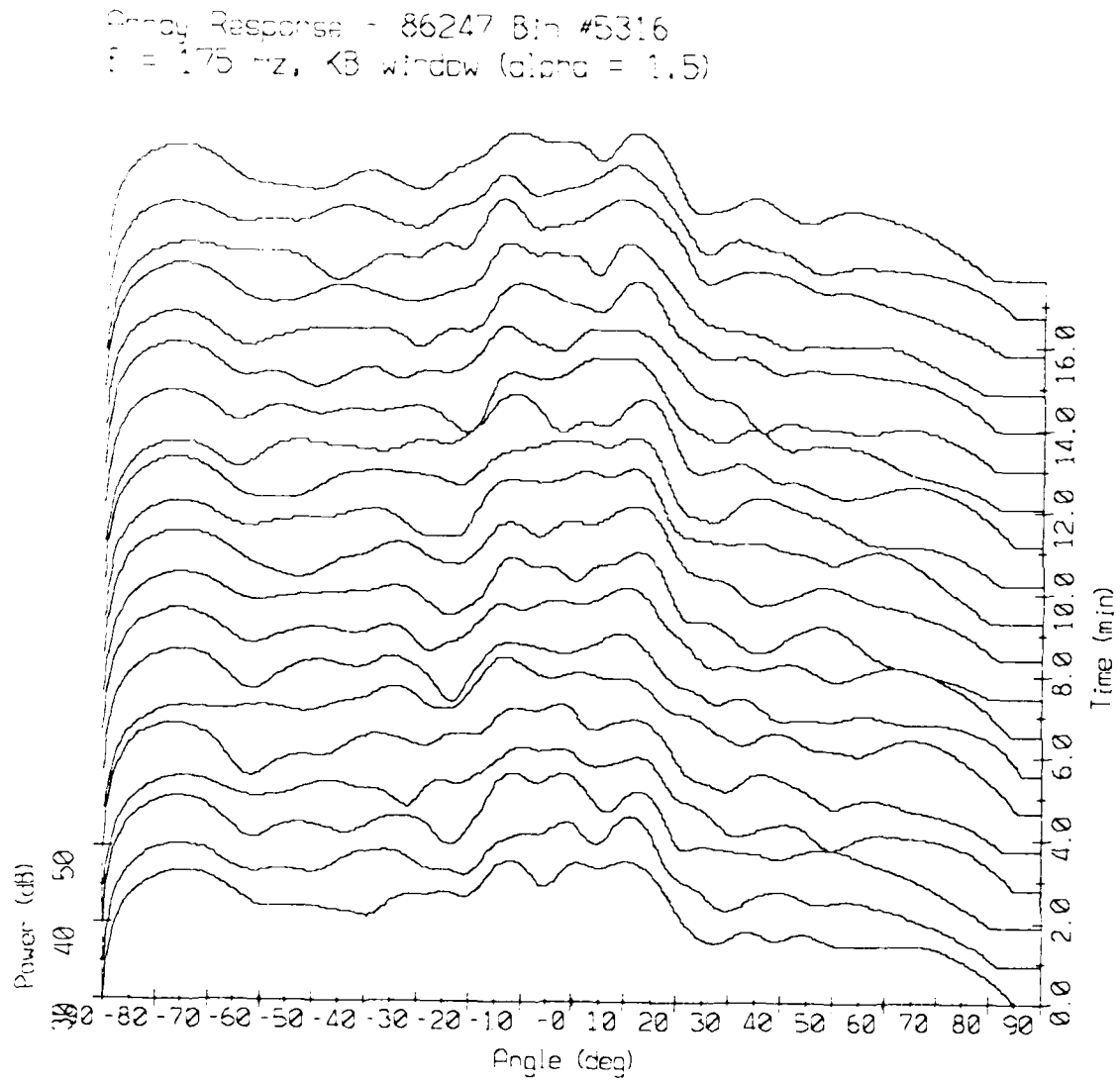

Array Response - 86247 Bin #444
f = 52 Hz, KB window (alpha = 1.5)
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

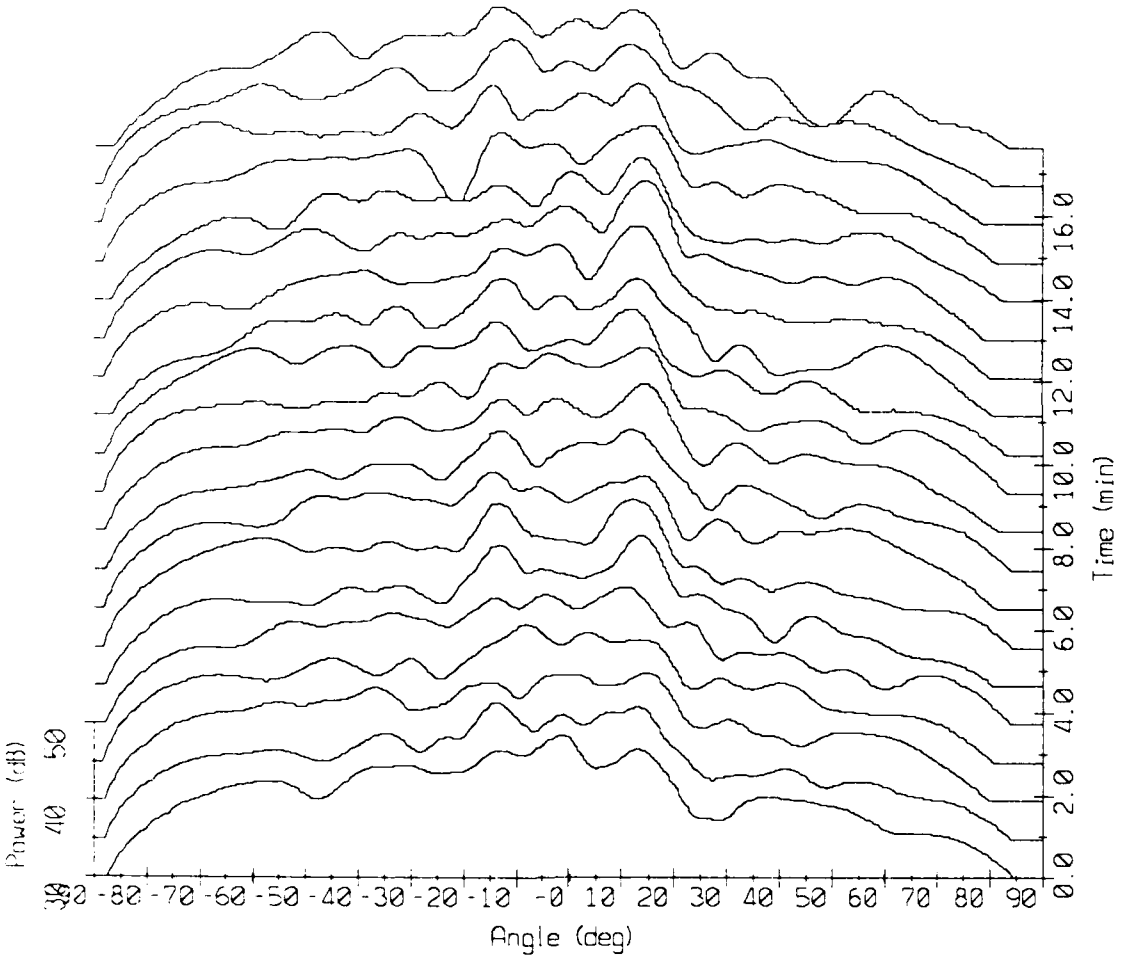

Array Response - 86247 Bin #4619
f = 75 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-82 -72 -62 -52 -42 -32 -22 -12 -2 12 22 32 42 52 62 72 82 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

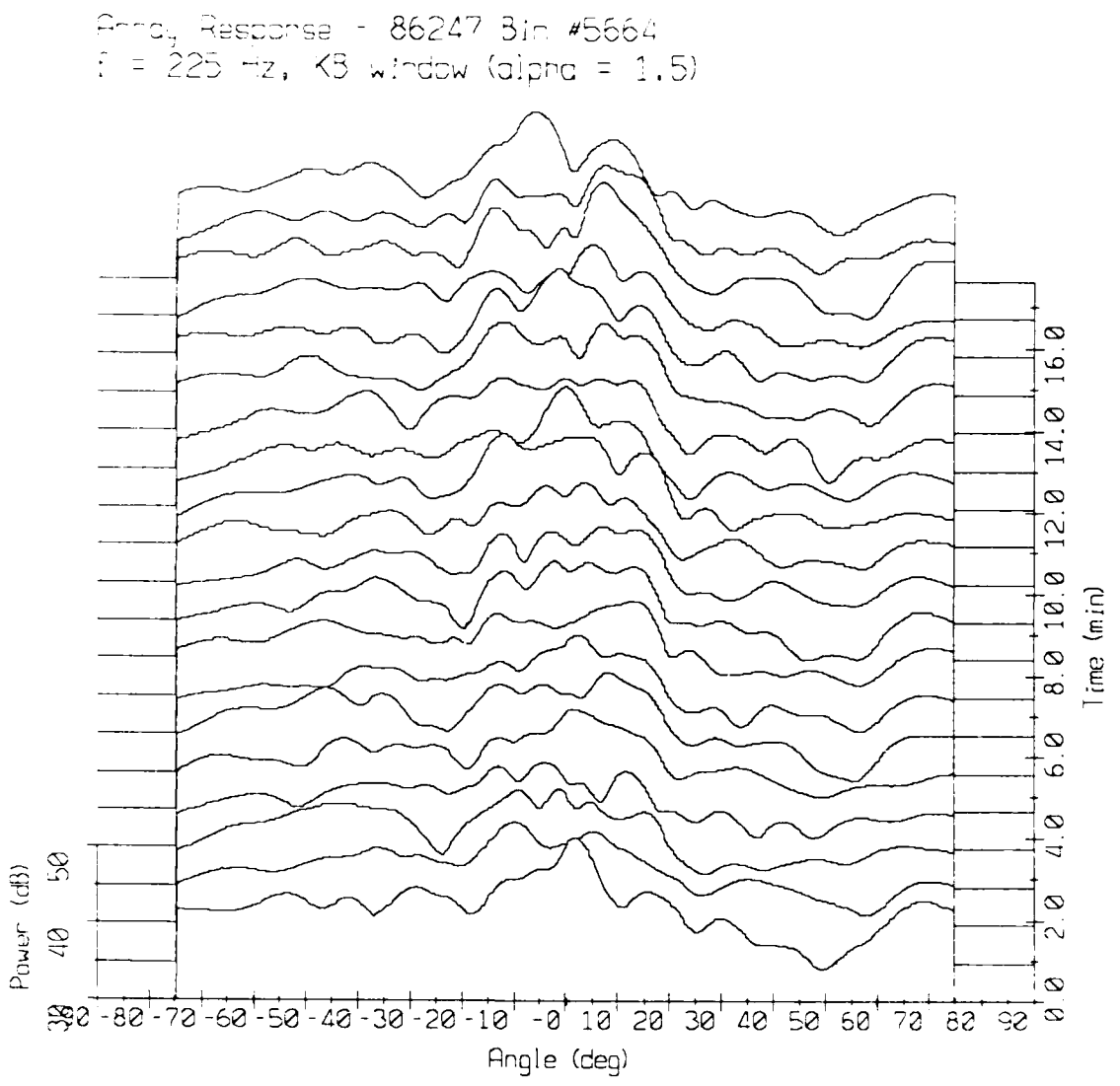

Array Response - 86247 Bin #4793
f = 100 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

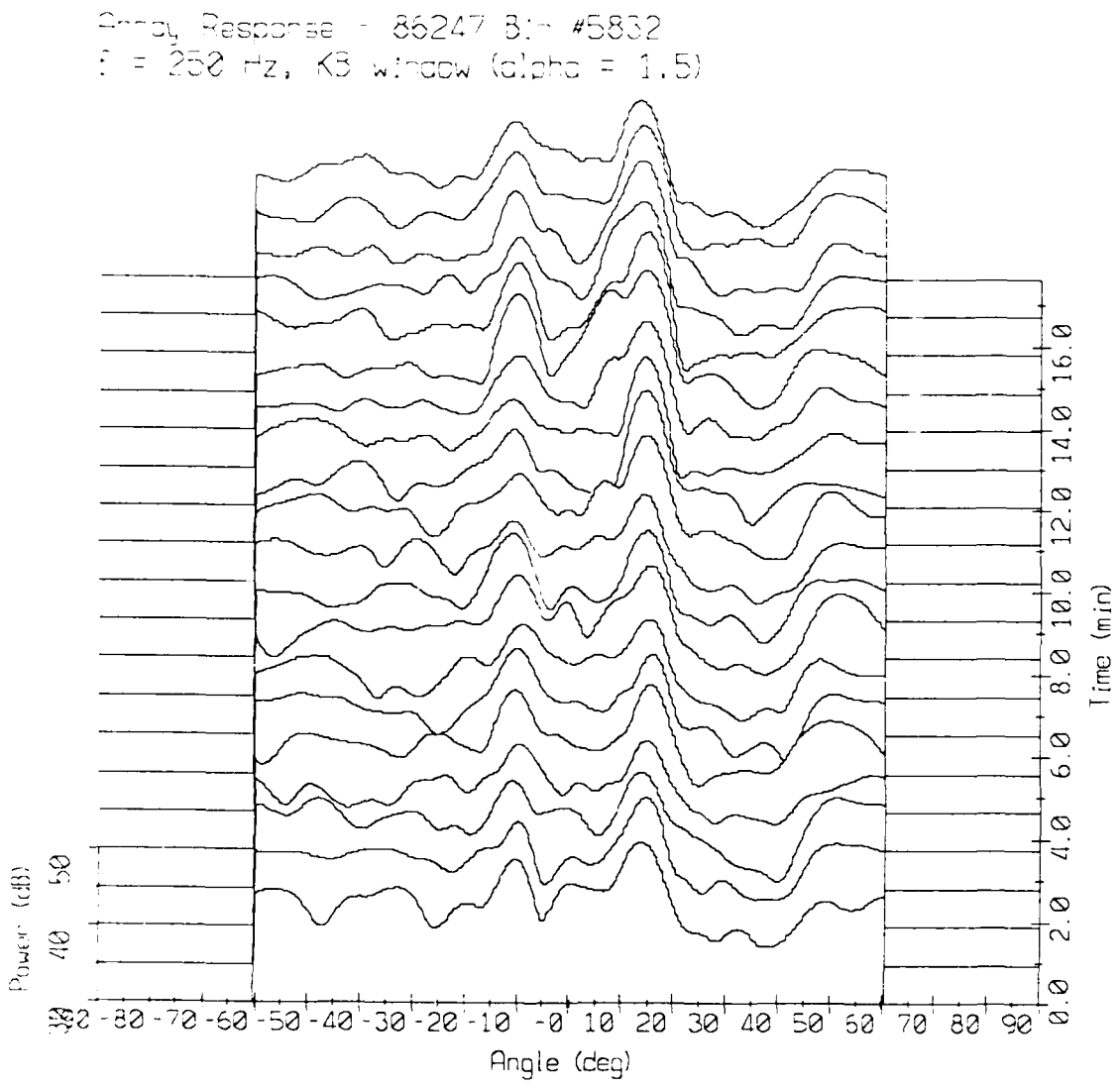

Array Response - 86247 Bin #4967
f = 125 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

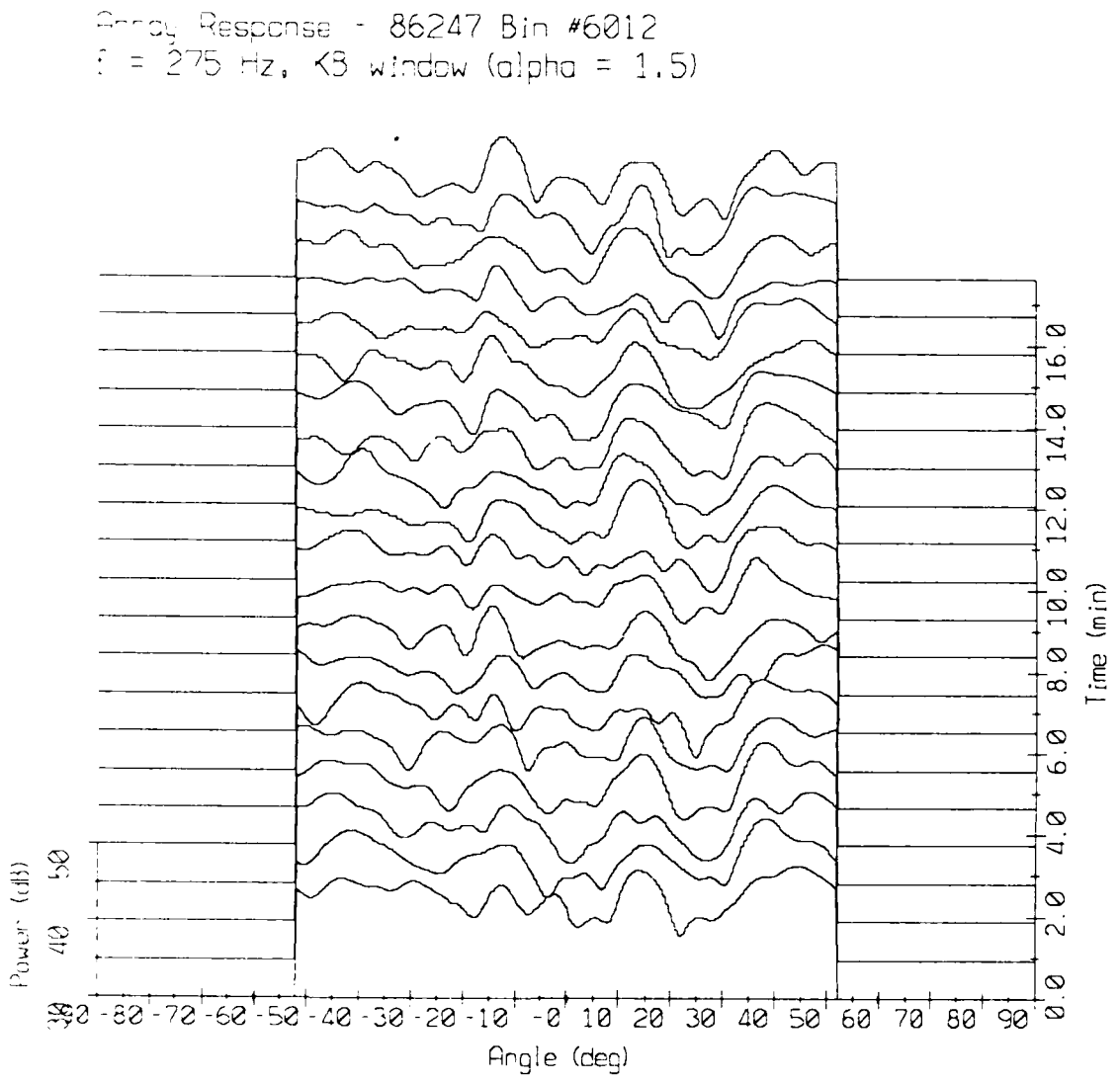

Array Response - 86247 Bin #5141
f = 150 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

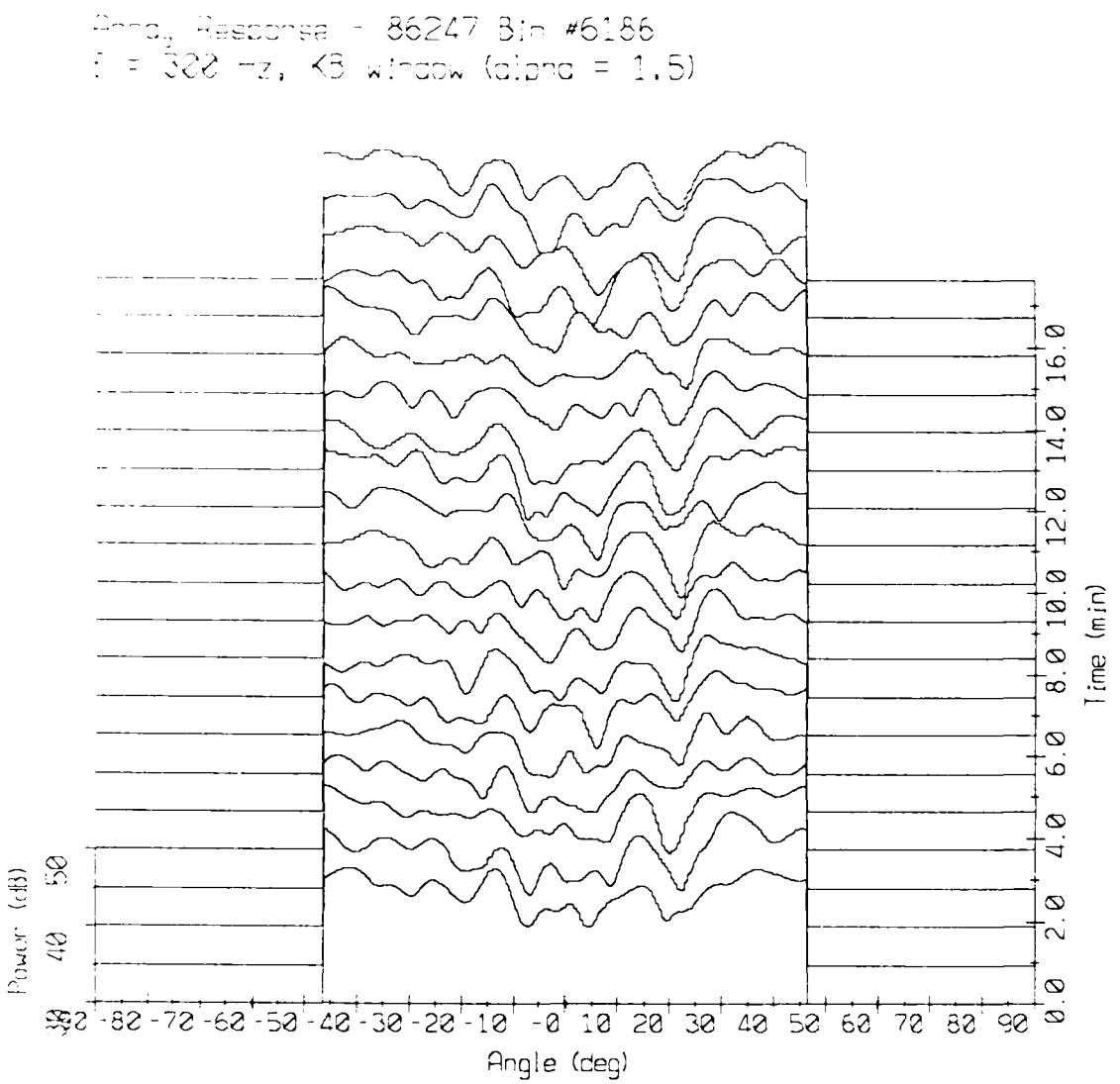

Array Response - 86247 Bin #5316
f = 175 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)


Array Response - 86247 Bin #5498
f = 220 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

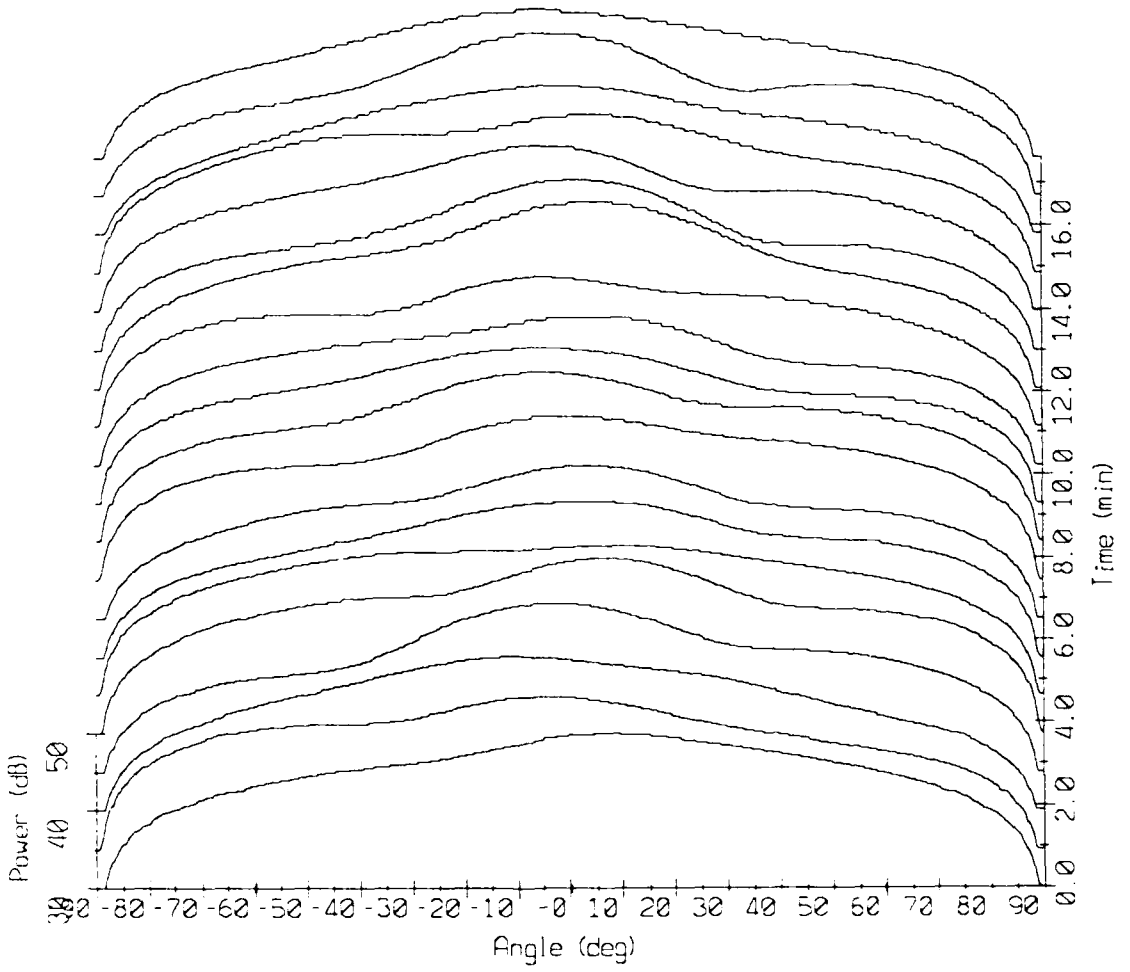

Array Response - 86247 Bin #5664
f = 225 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

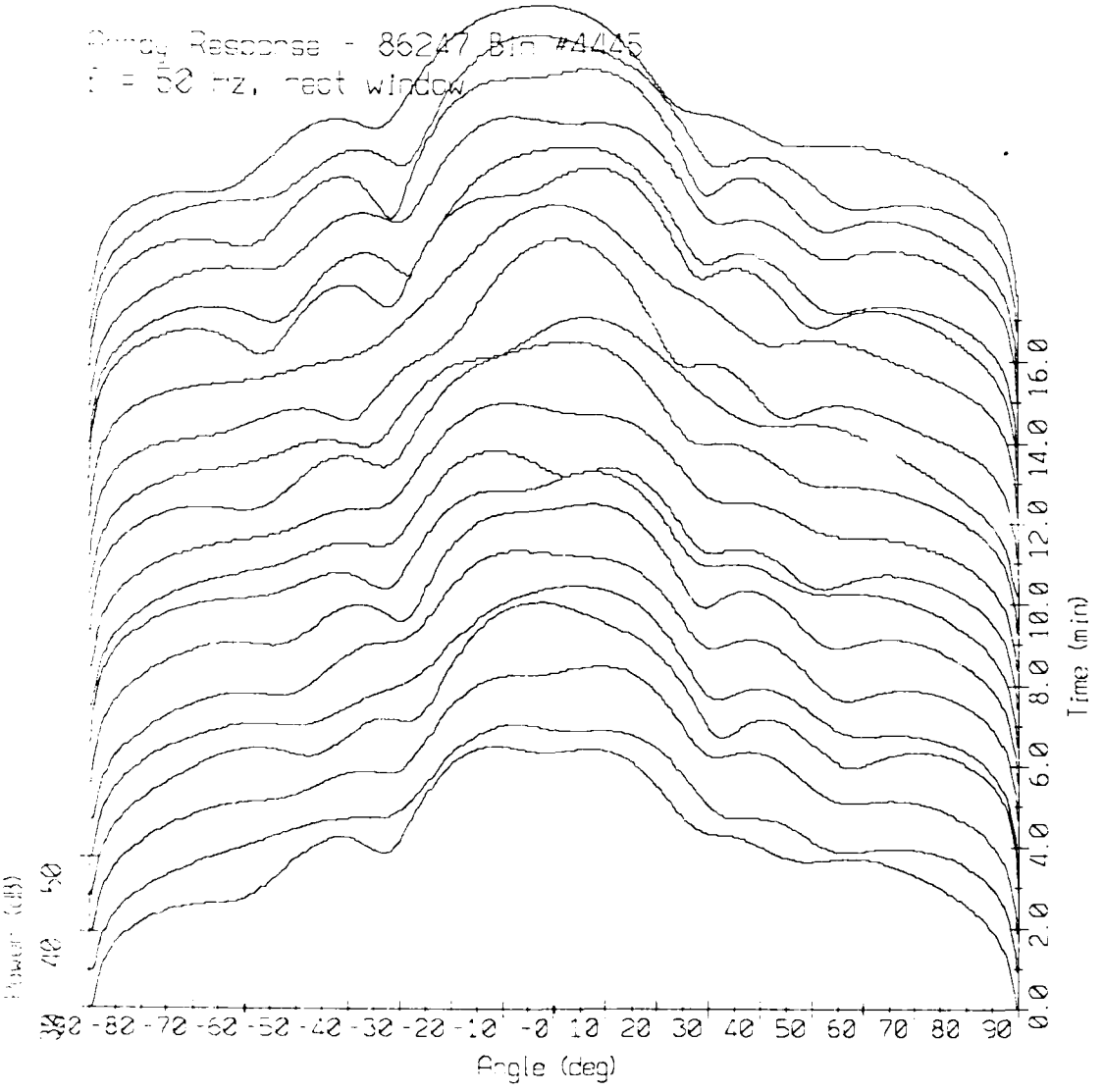

Array Response - 86247 Bin #5832
f = 250 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

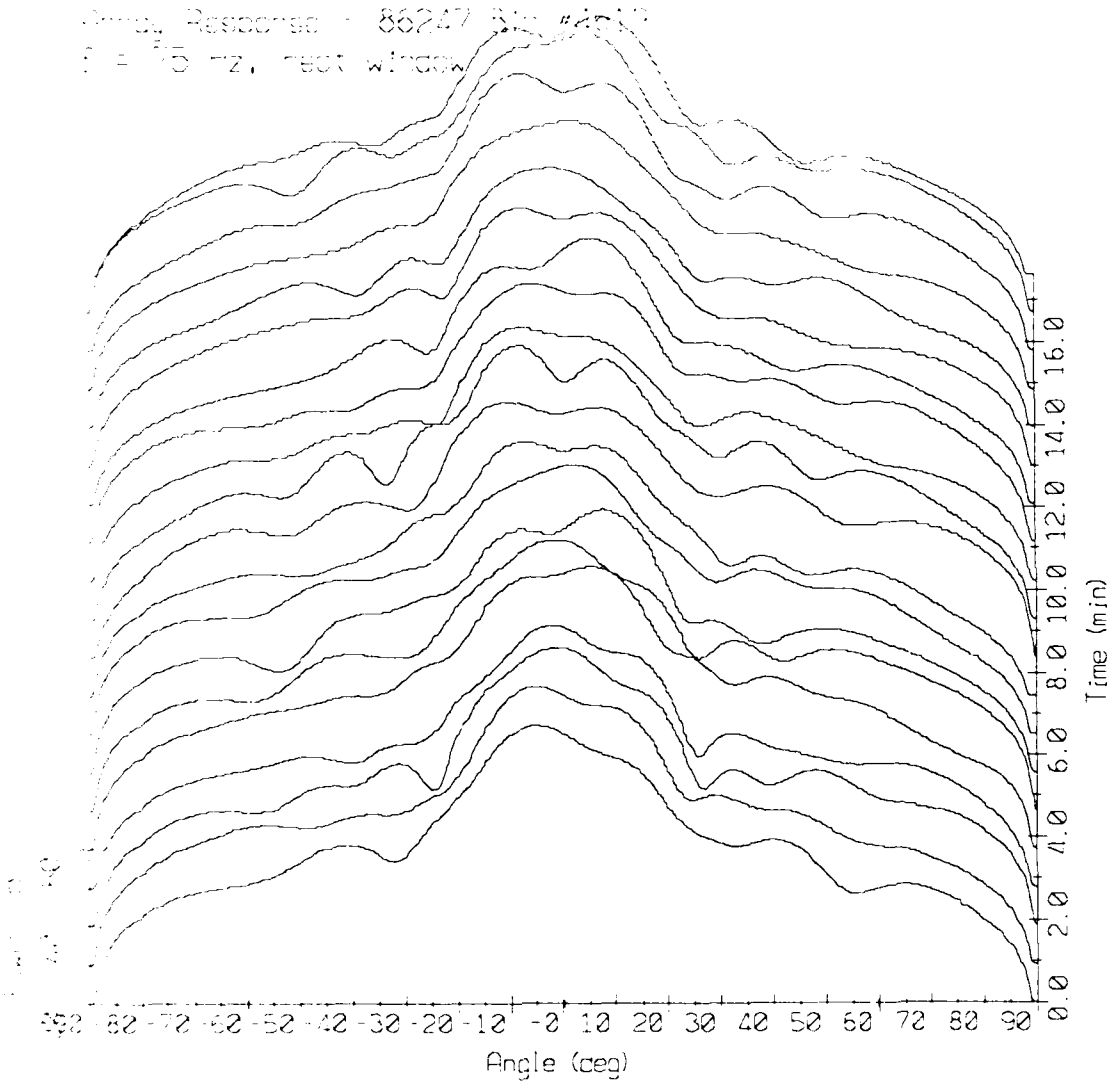

Array Response - 86247 Bin #6012
f = 275 Hz, KB window (alpha = 1.5)
Power (dB)
30
40
50
-80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

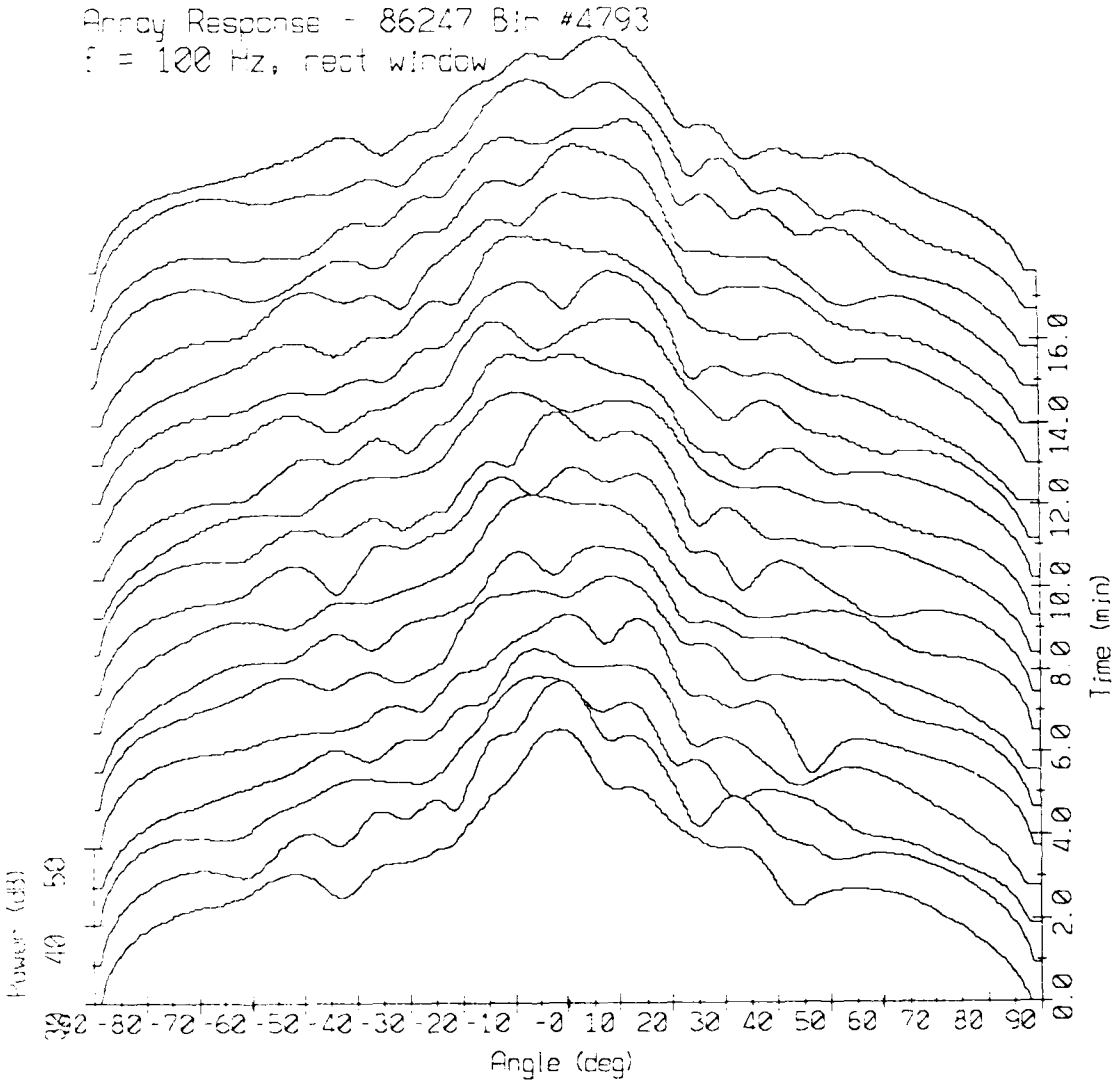

Array Response - 86247 Bin #6186
f = 320 Hz, KB window (alpha = 1.5)
Power (dB)
40
50
-82 -72 -62 -52 -42 -32 -22 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

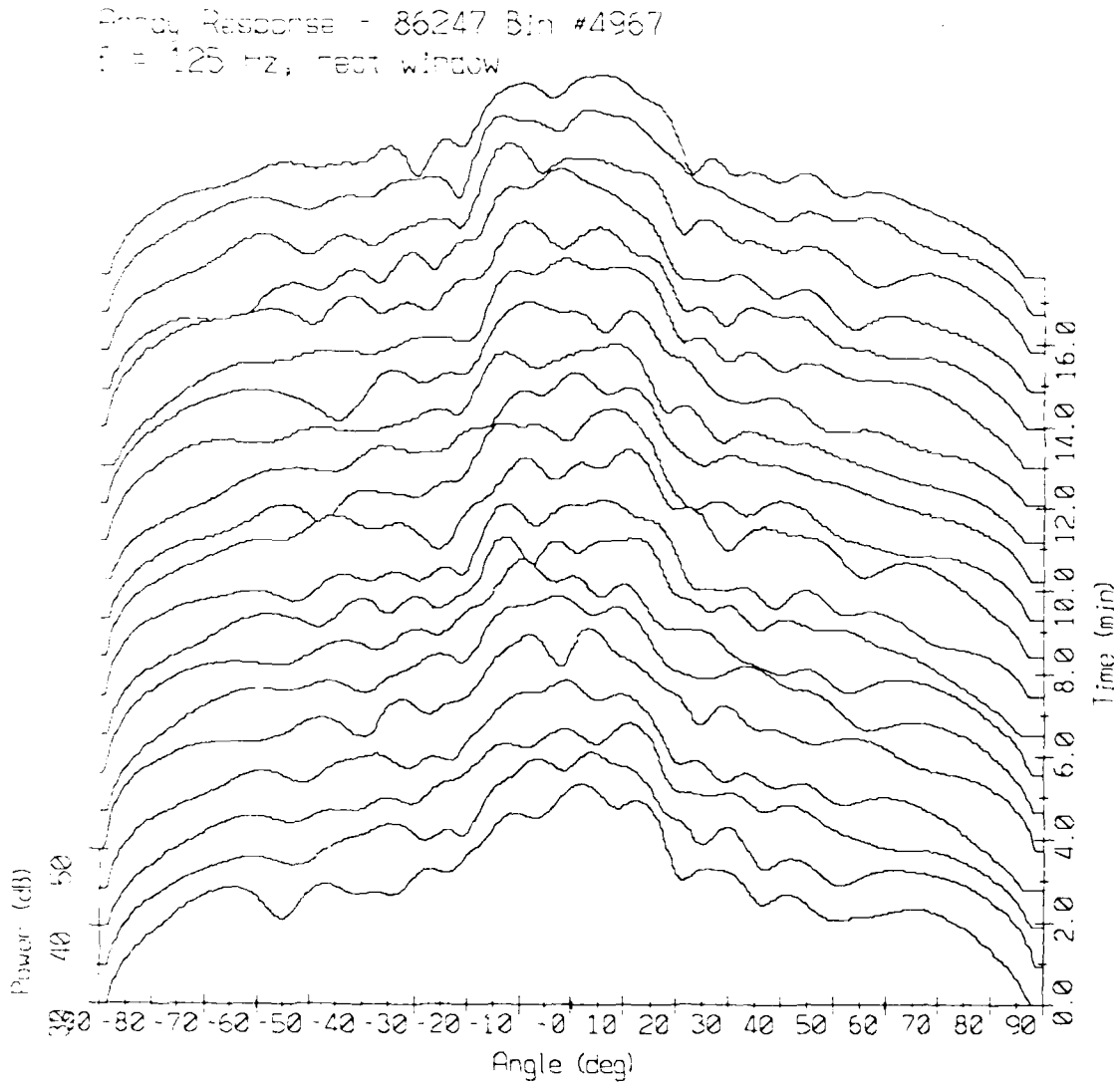
V. Array Response: Waterfall, Rect Window.

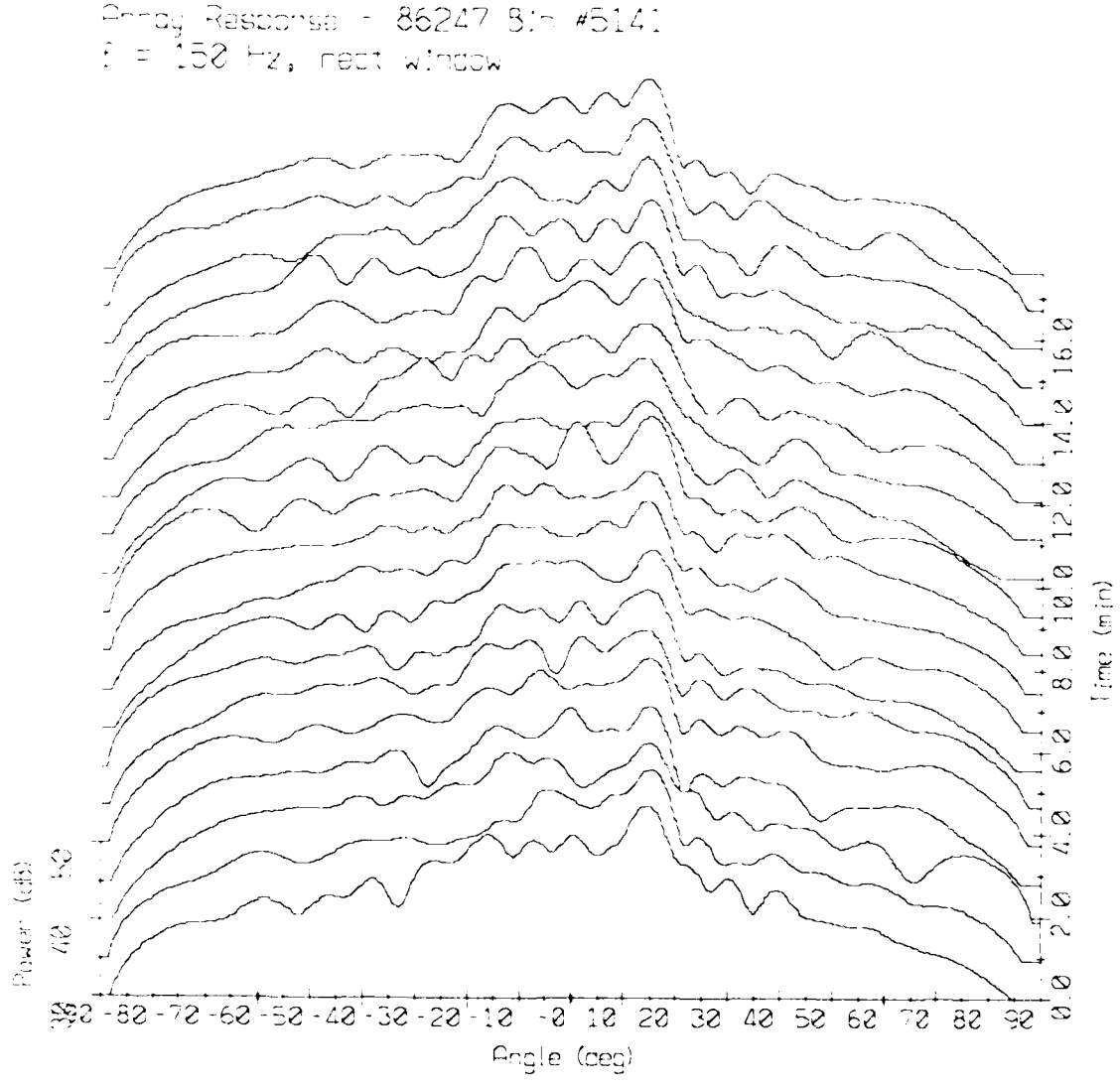

Array Response - 86247 Bin #4271
f = 25 Hz, rect window
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

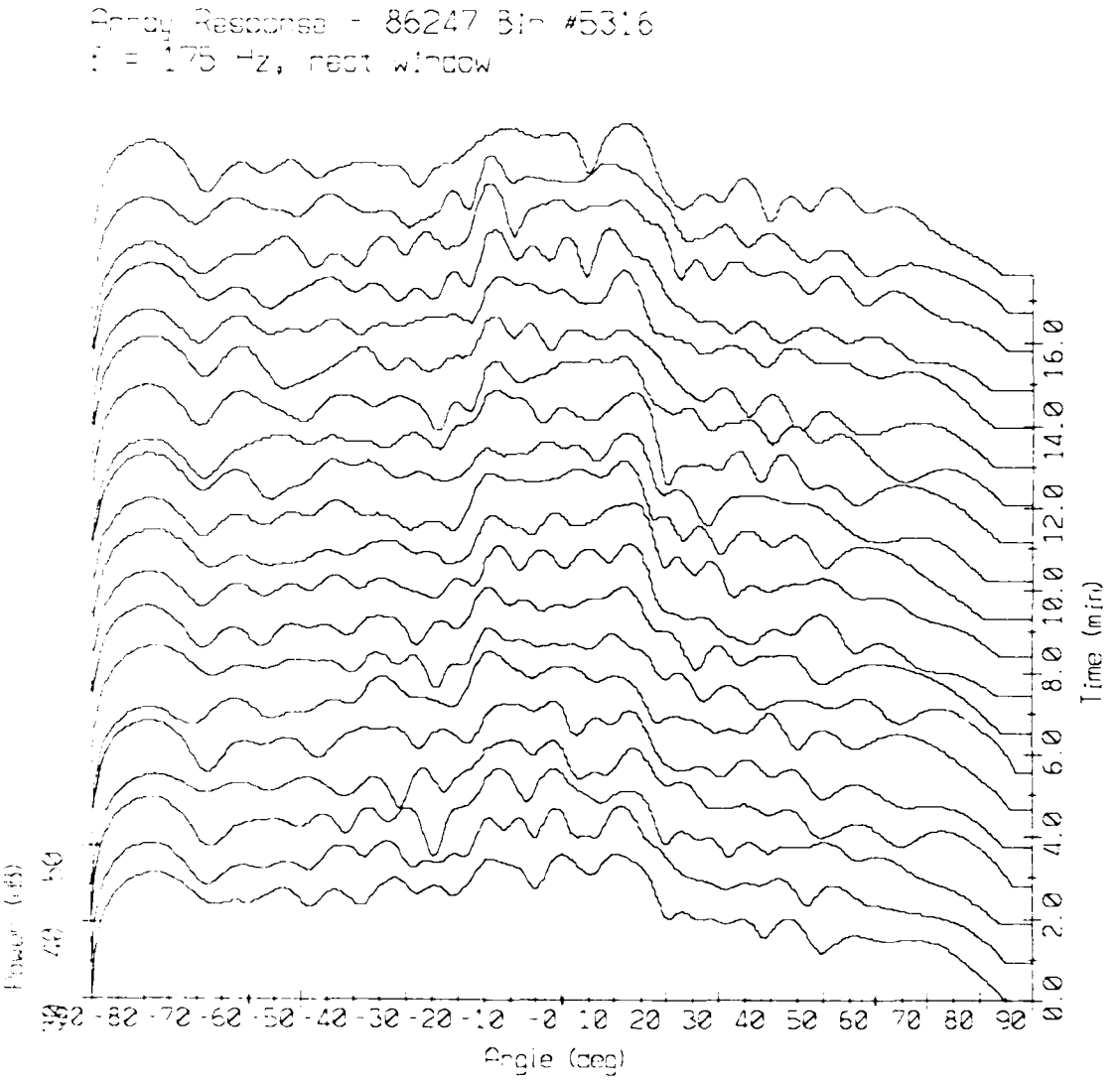

Array Response - 86247 Bin #4465
f = 50 Hz, rect window
Power (dB)
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

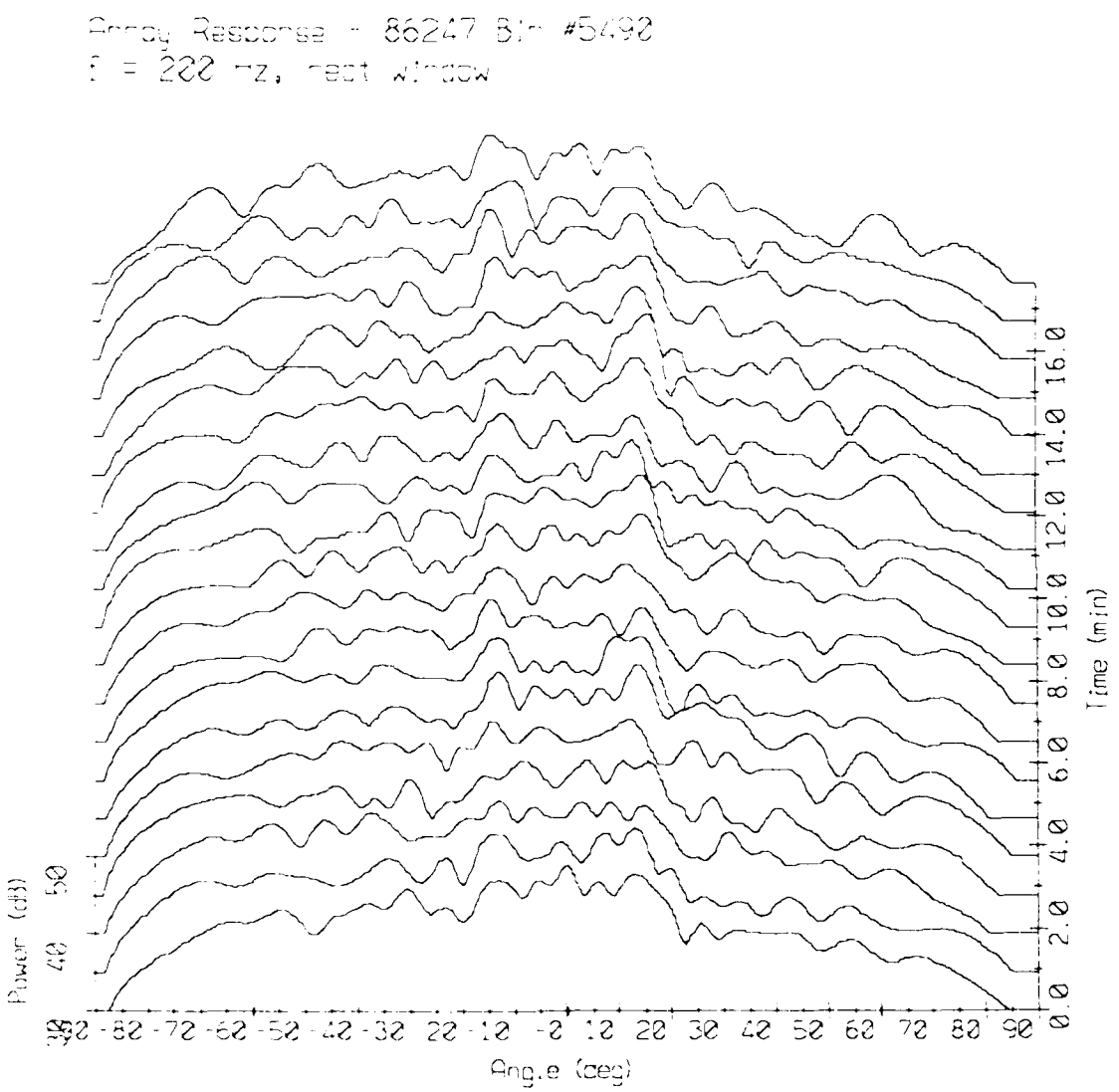

0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Time (min)
-90 -82 -72 -62 -52 -42 -32 -20 -12 -2 12 20 30 40 50 60 72 82 90
Angle (deg)

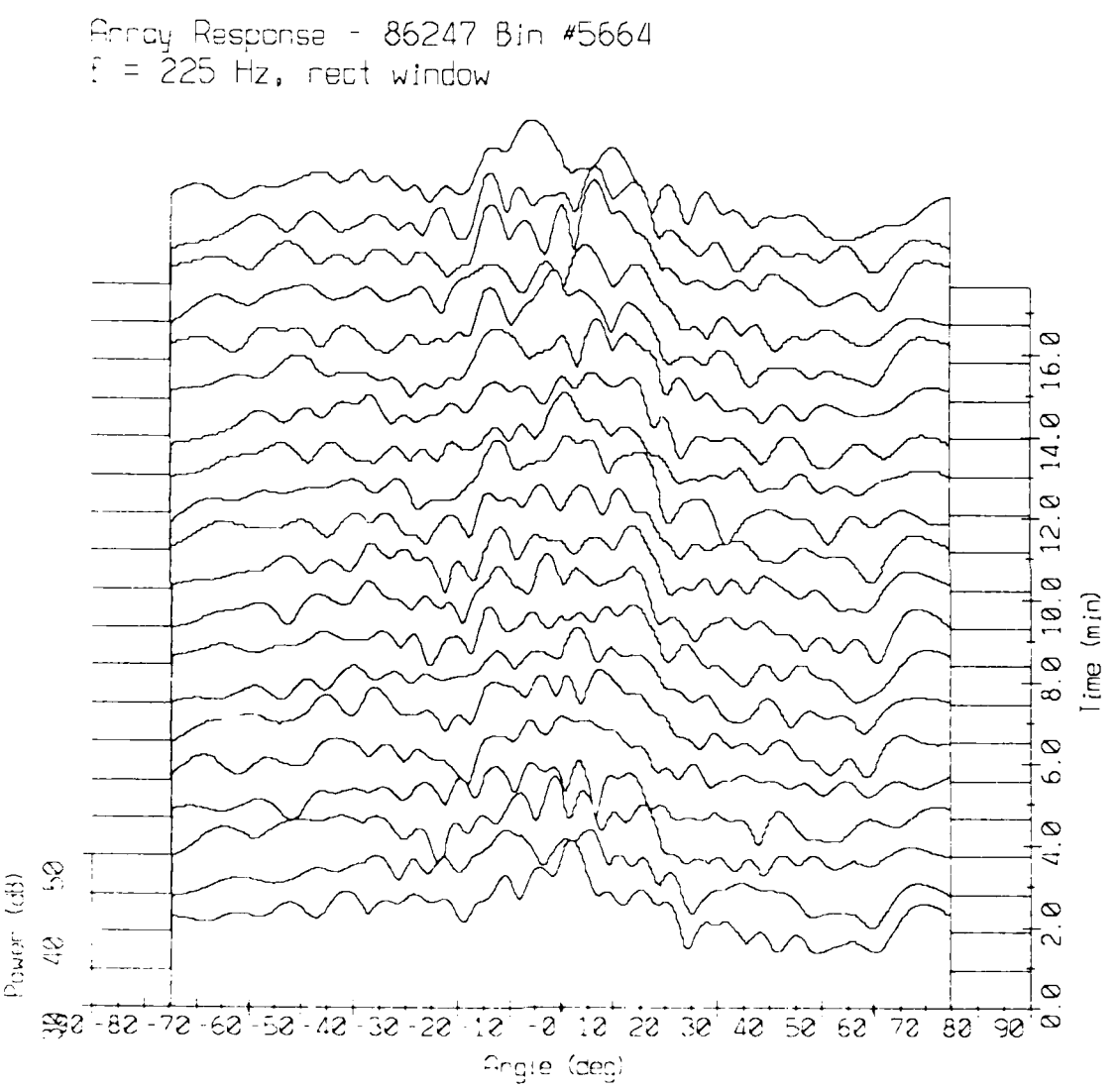

Array Response - 86247 Bin #4793
f = 100 Hz, rect window
Power (dB)
30
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

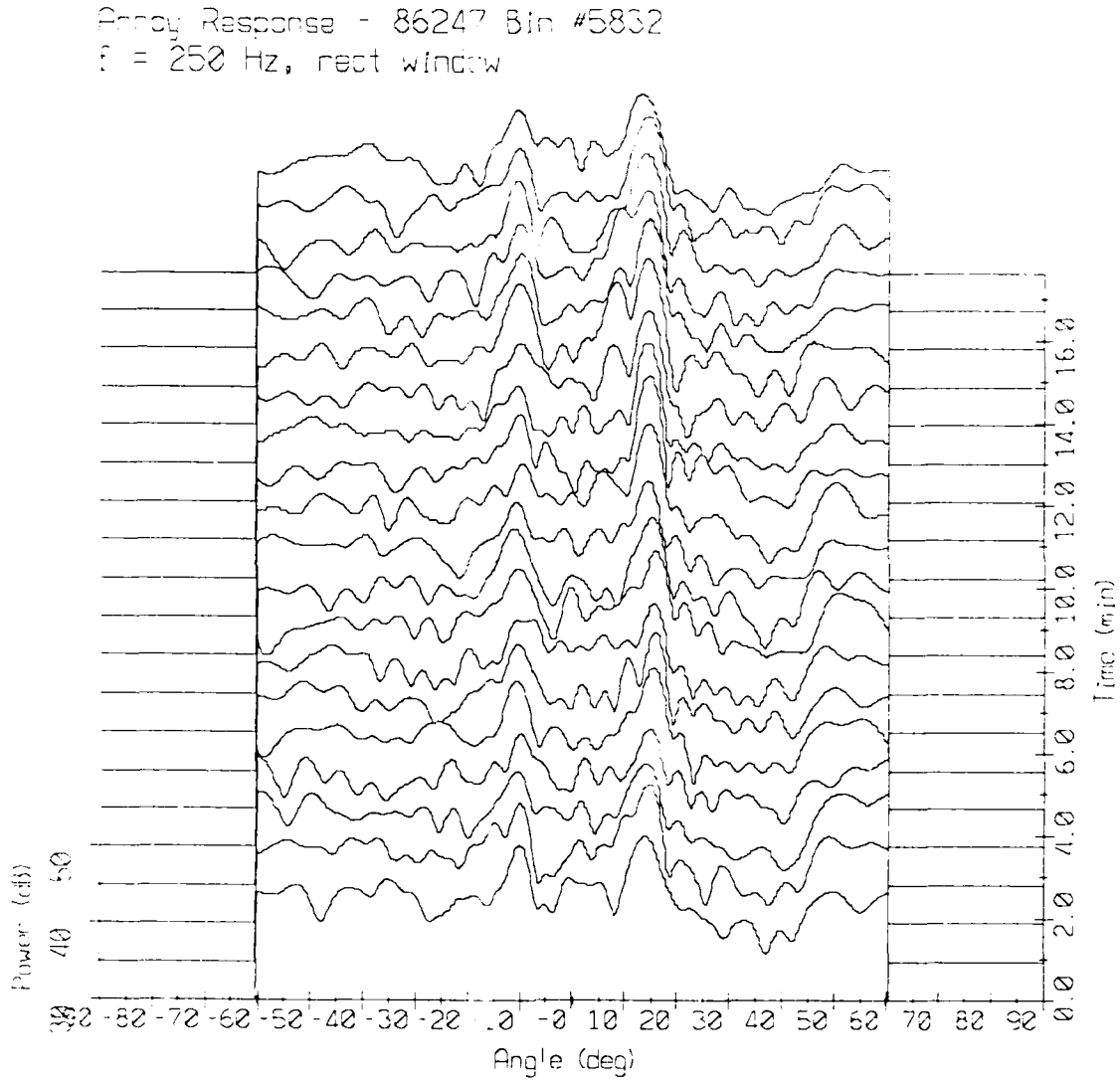

Array Response - 86247 Bin #4967
f = 125 Hz, rect window
Power (dB)
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

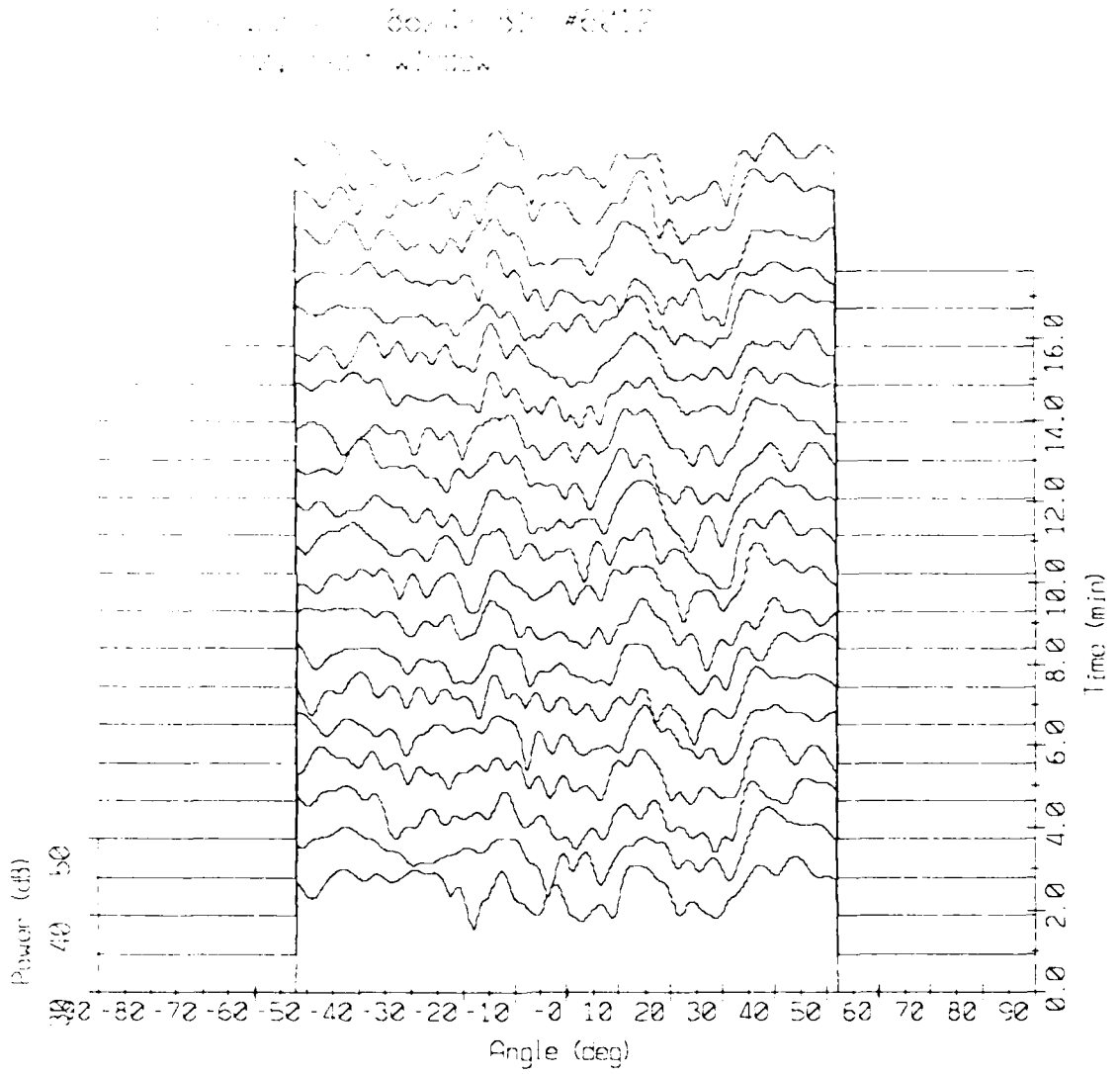

Array Response - 86247 Bin #5141
f = 150 Hz, rect window
Power (dB)
40
50
-82 -72 -62 -52 -42 -32 -22 -12 -2 12 22 32 42 52 62 72 82 92
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

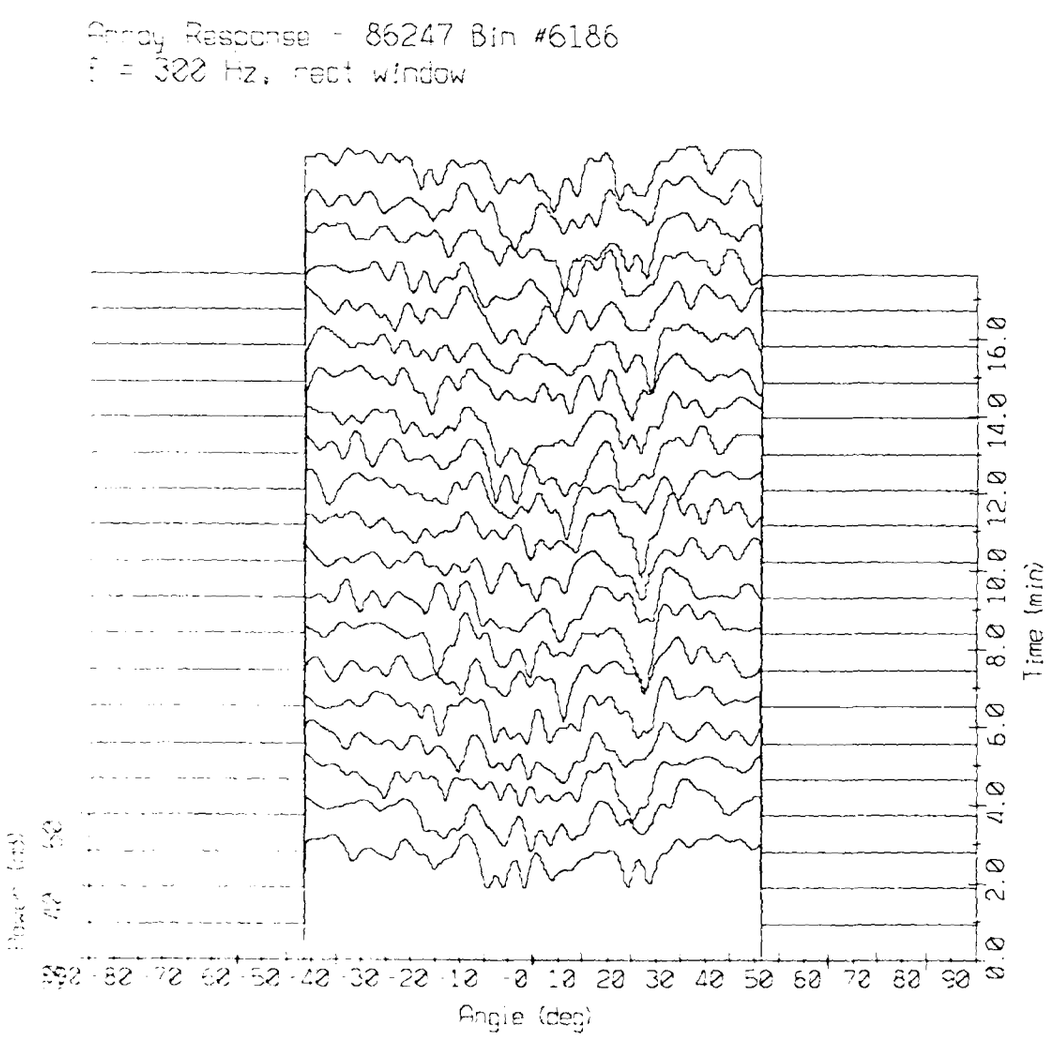

Array Response - 86247 Bin #5316
f = 175 Hz, rect window
Power (dB)
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)


Array Response - 86247 Bin #5498
f = 222 Hz, rect window
Power (dB)
40
50
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)


Array Response - 86247 Bin #5664
f = 225 Hz, rect window
Power (dB)
Angle (deg)
Time (min)
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0


Array Response - 86247 Bin #5832
f = 250 Hz, rect window
Power (dB)
40
50
-82 -72 -62 -52 -40 -30 -20 -0 -0 10 20 30 40 50 60 70 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

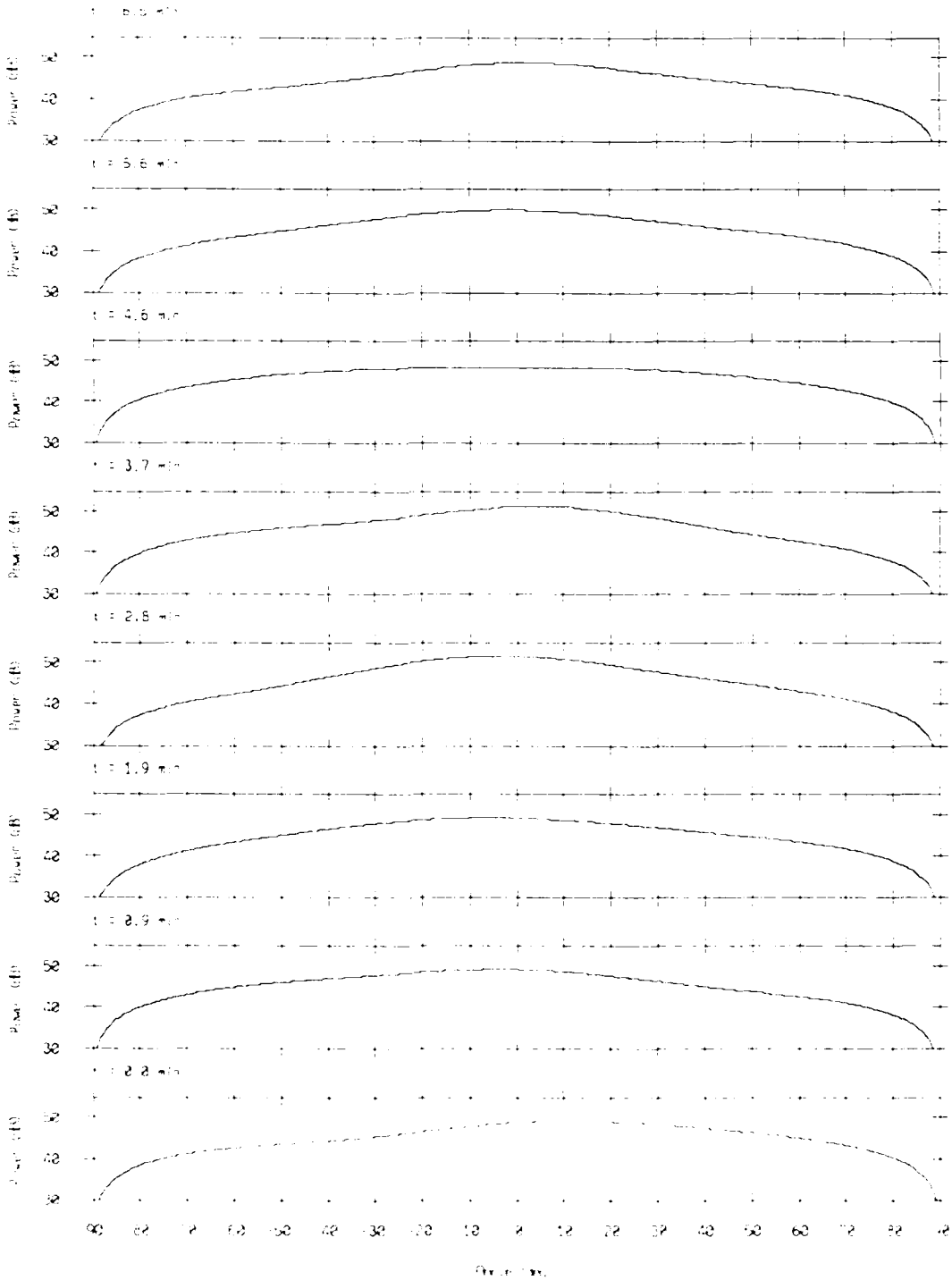

Power (dB)
40
50
-82 -72 -62 -52 -42 -32 -22 -10 -0 10 20 30 40 50 62 72 80 90
Angle (deg)
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0
Time (min)

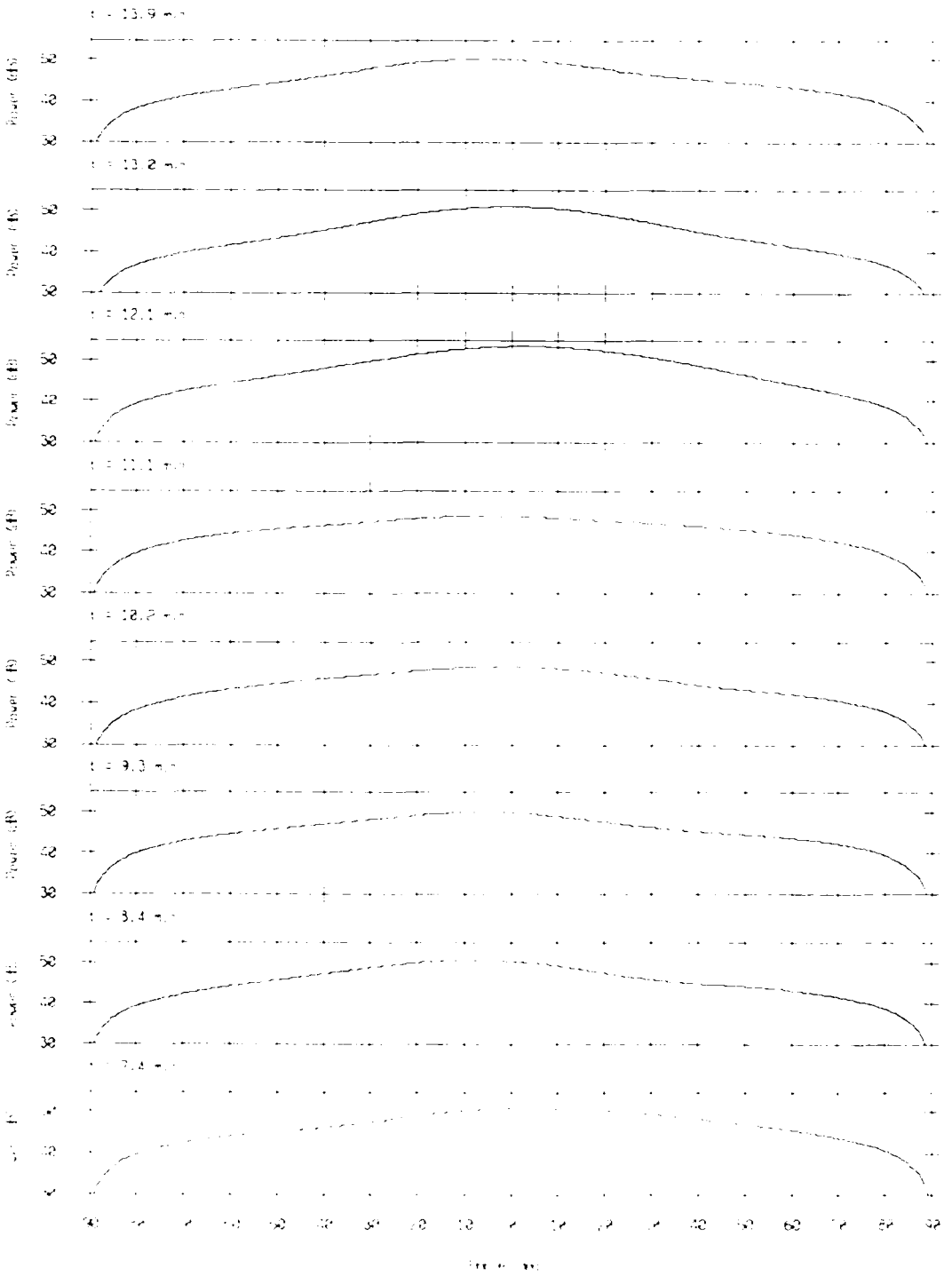

Array Response - 86247 Bin #6186
f = 322 Hz, rect window
Time (min)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
-90 -80 -70 -60 -50 -40 -30 -20 -10 -0 10 20 30 40 50 60 70 80 90
Angle (deg)

VI. Array Response: Panels, KB Window.

Array Response - 86247 Bin #4271

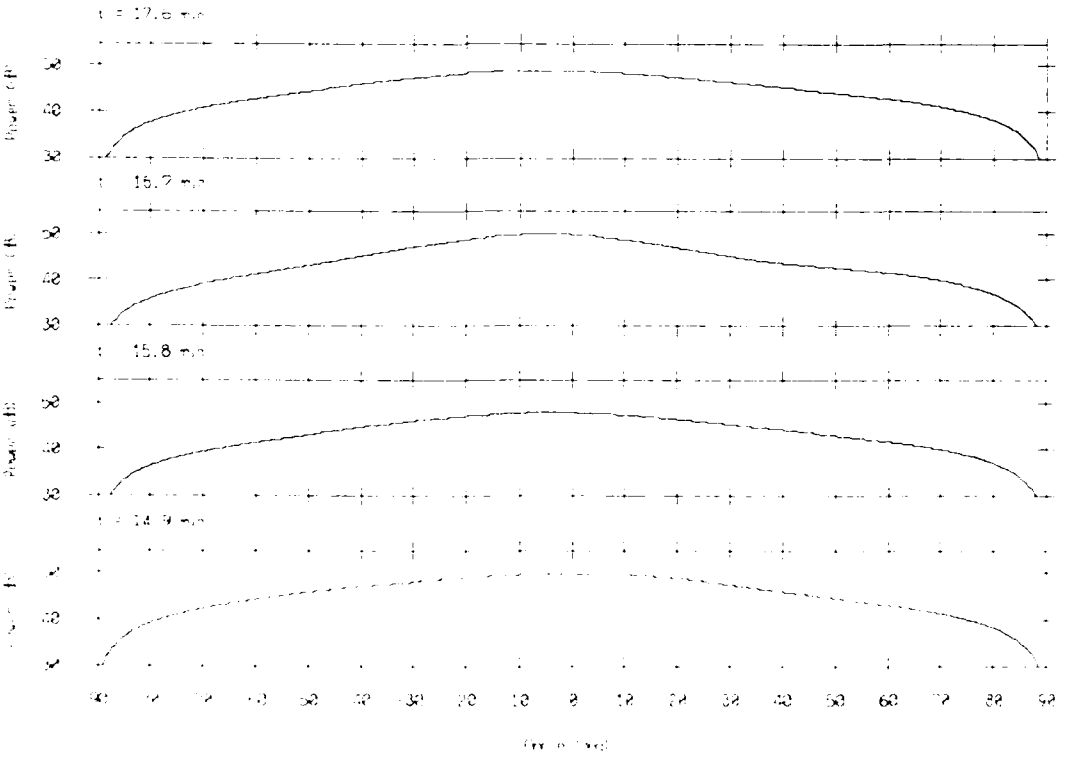
f = 25 Hz, KB window (alpha = 1.5)

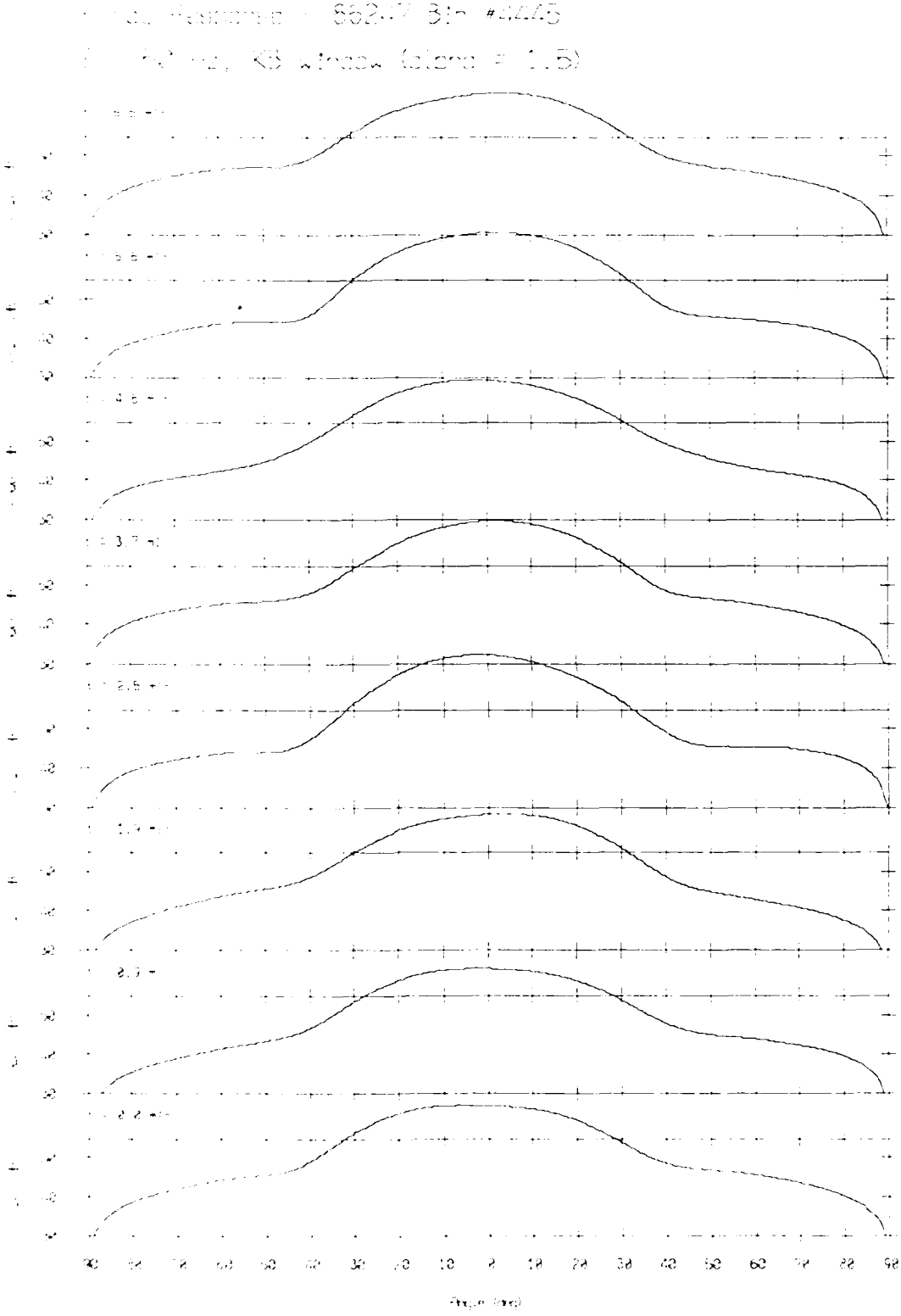


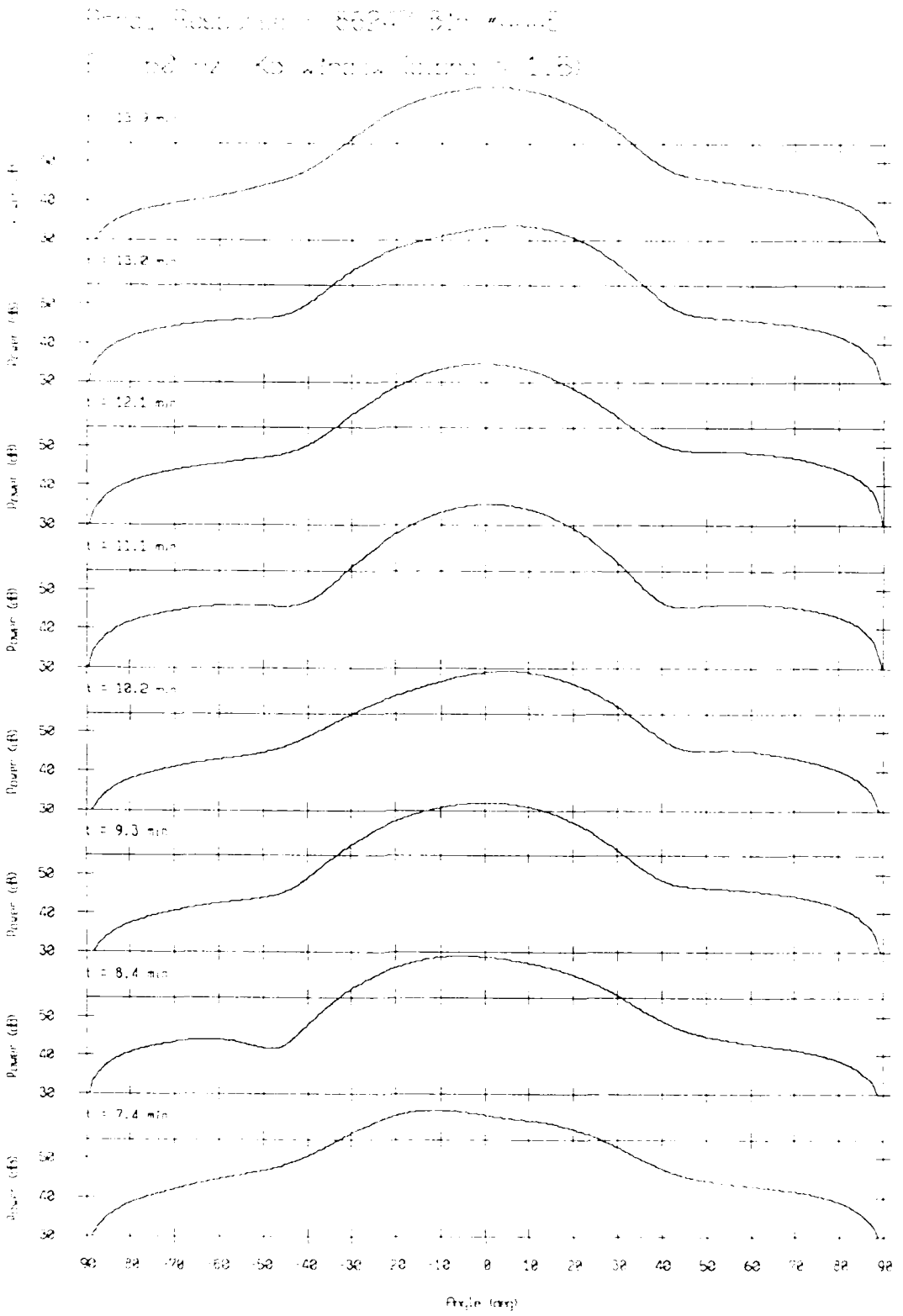

Array Response - 55247 Bin #271
f = 25 Hz, KB window (alpha = 1.5)

Array Response - 88247 Bin #4271

f = 25 Hz, KB window (alpha = 1.5)

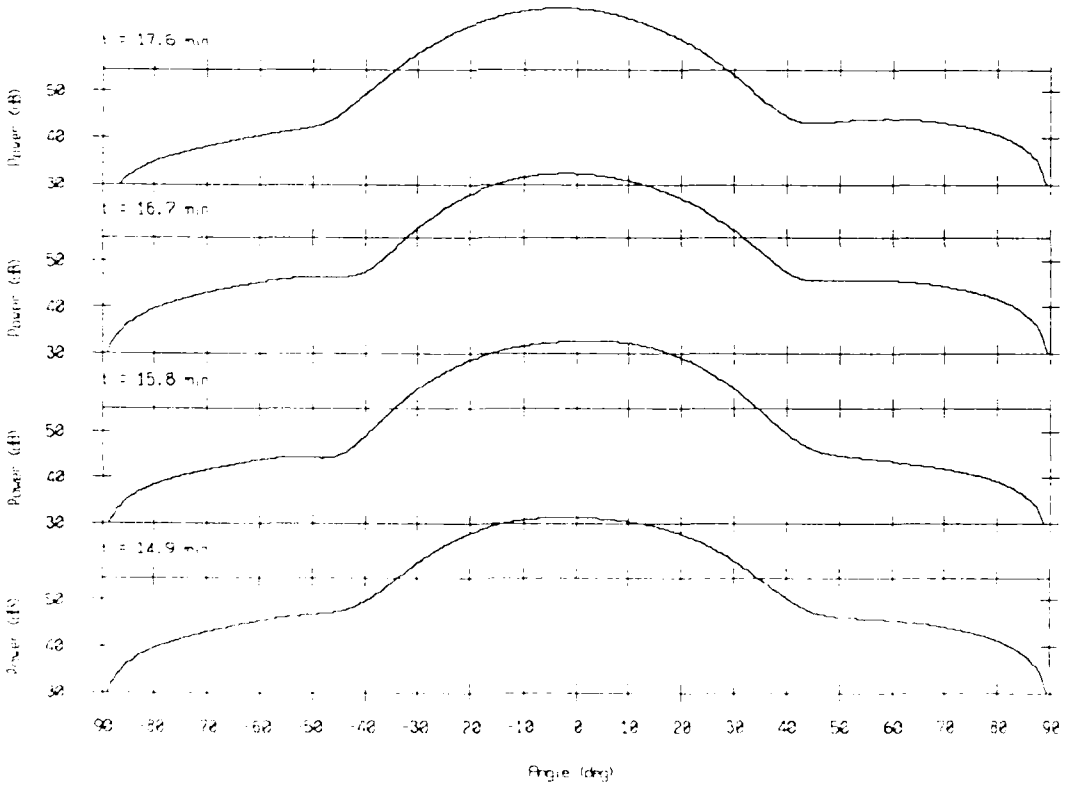


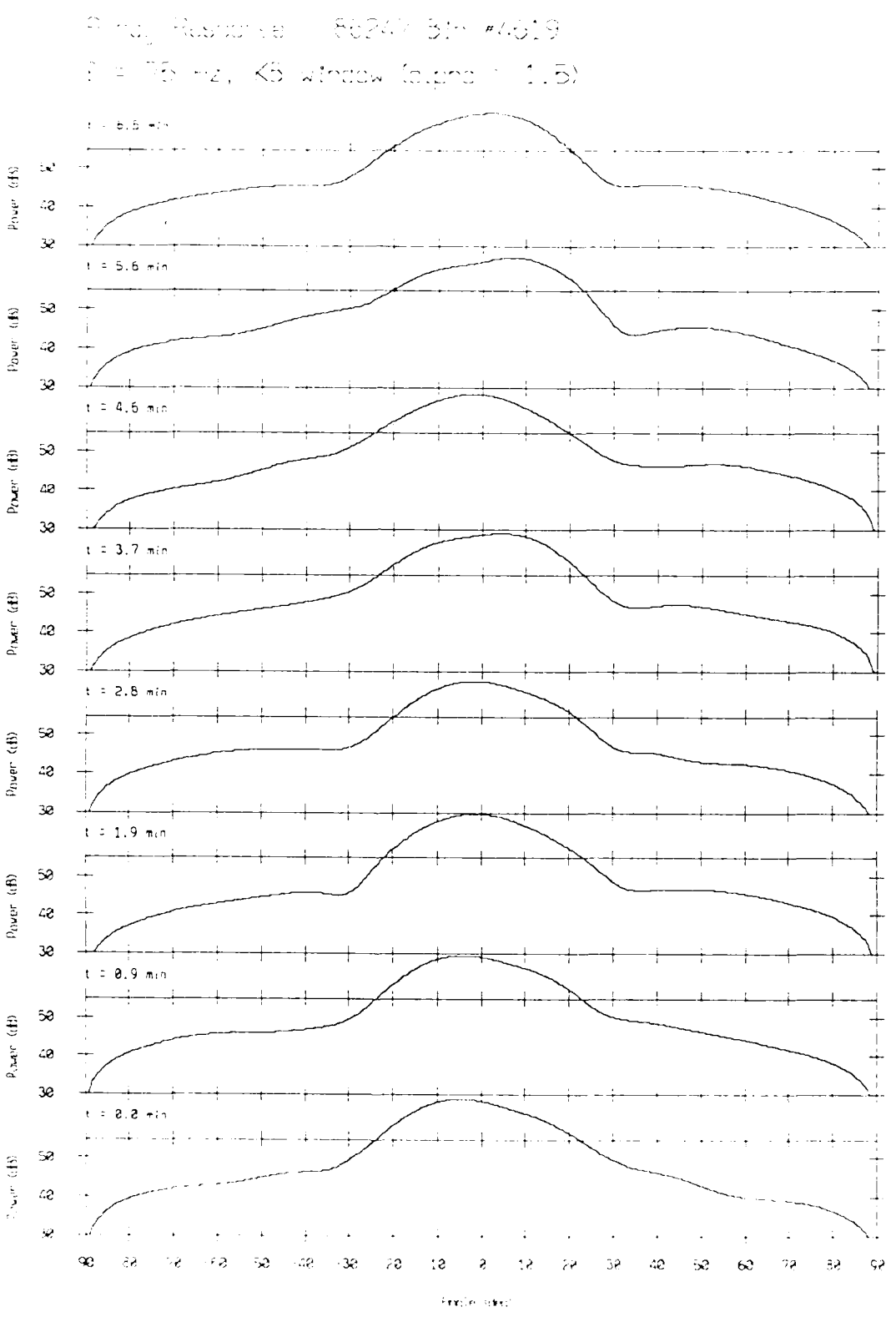


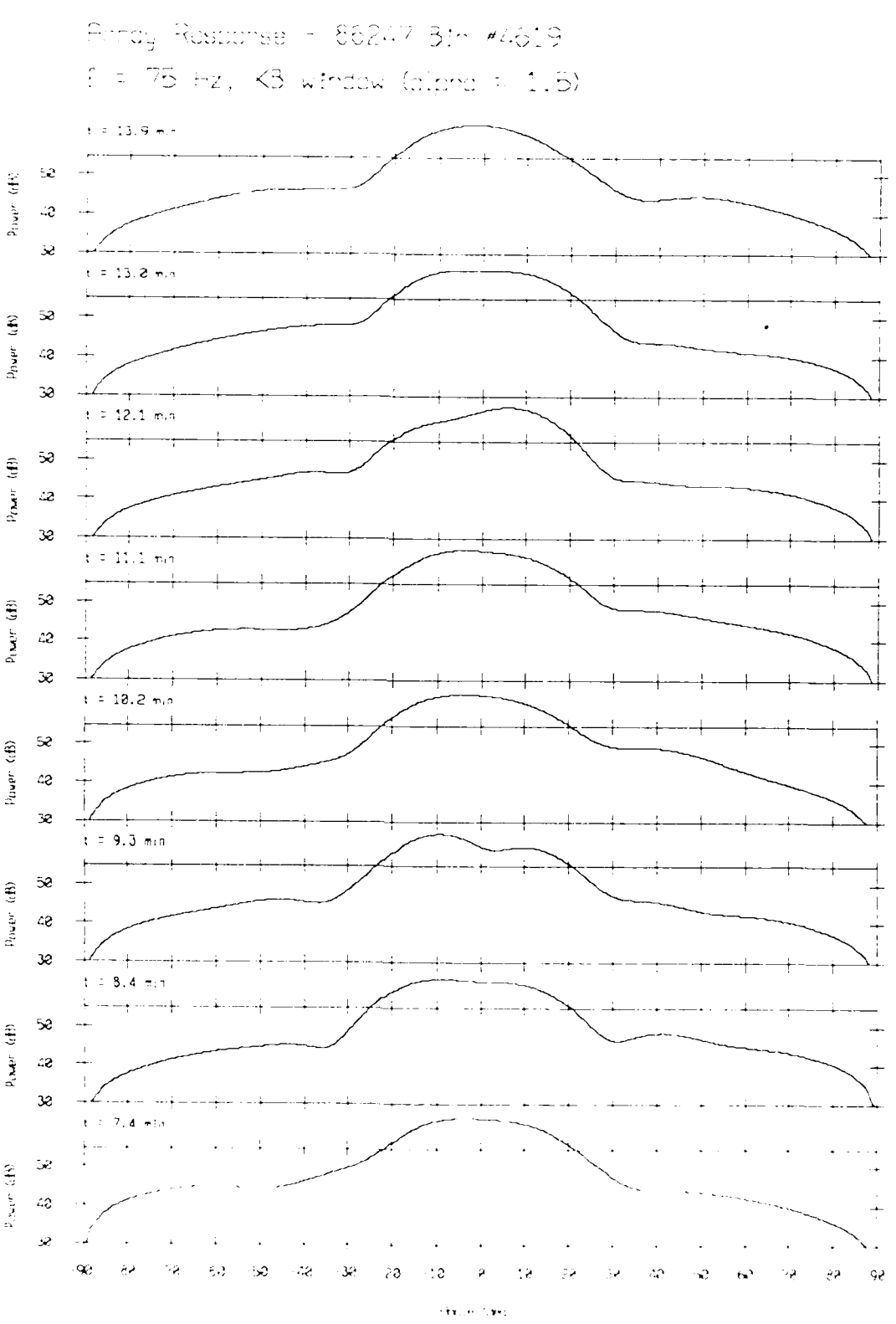

t = 13.7 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90

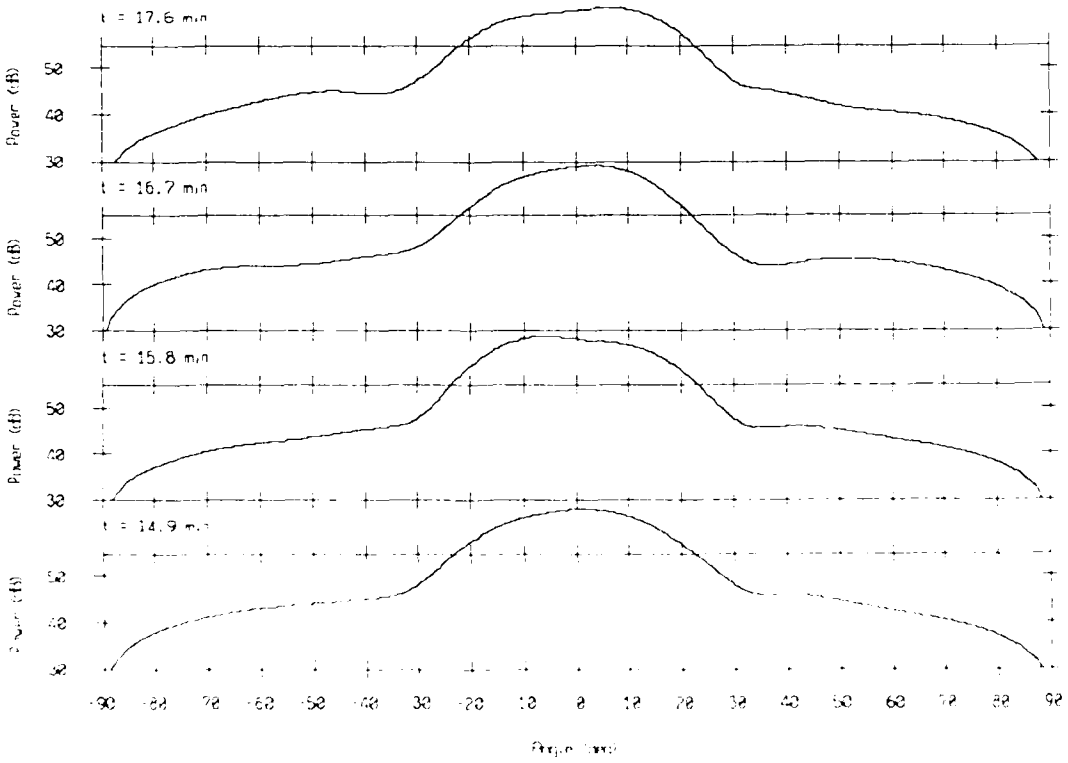
Array Response - 86247 Bin #XXX5

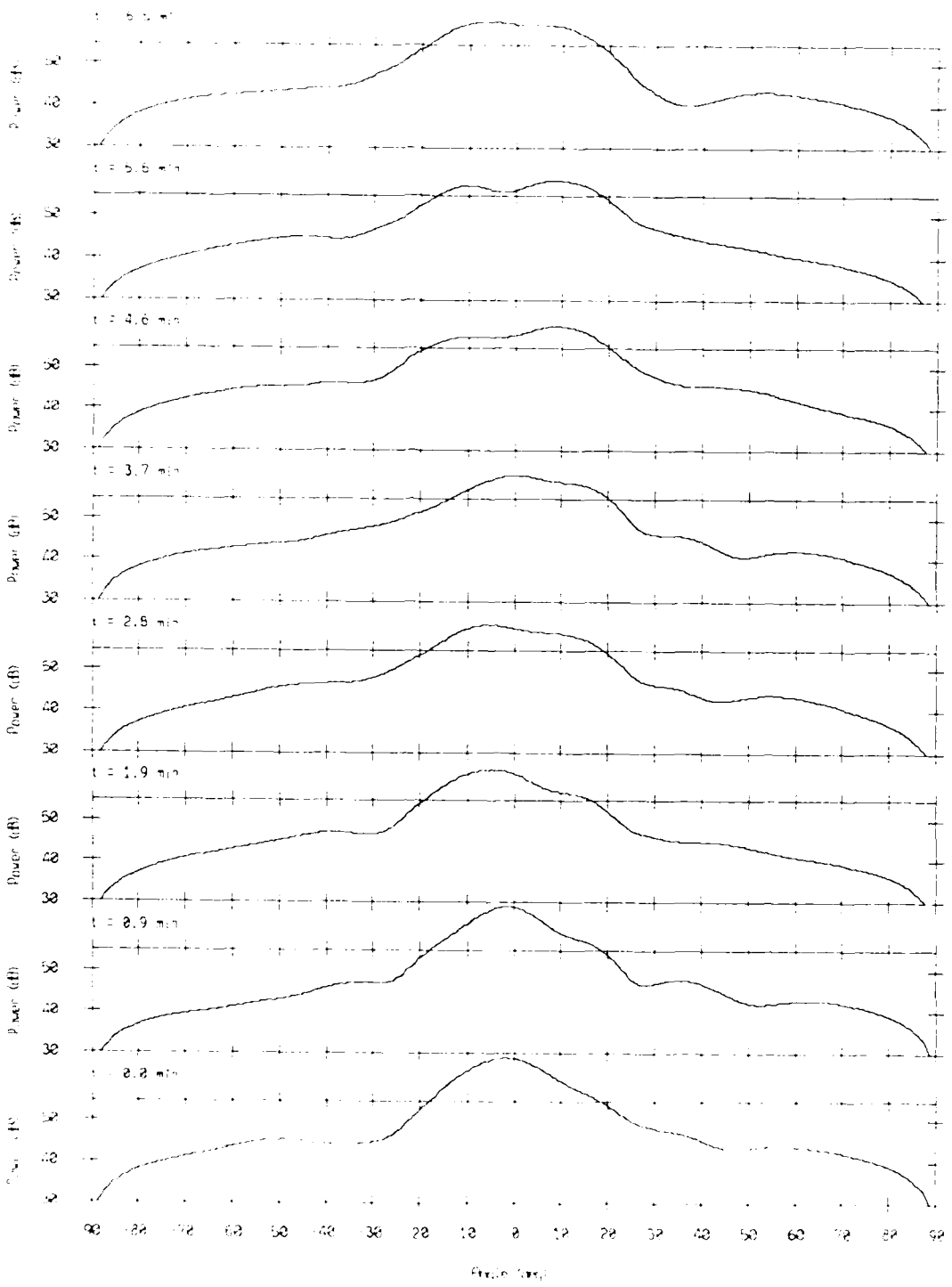
f = 52 Hz, KB window (alpha = 1.5)

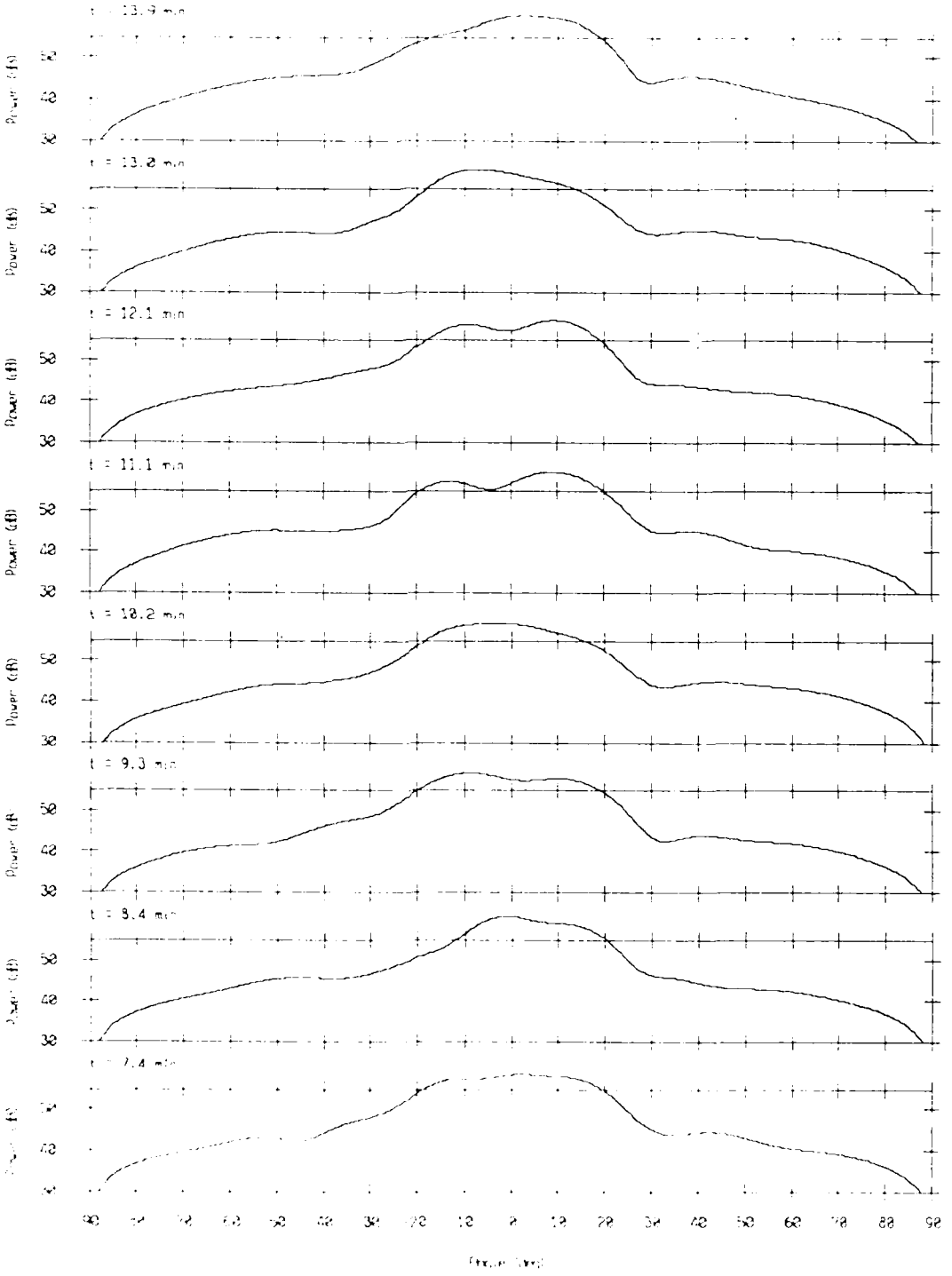



t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.2 min
Power (dB)
50
40
30


Array Response - 88247 Bin #4619
f = 75 Hz, KB window (alpha = 1.5)
t = 13.9 min
t = 13.0 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
50
40
30

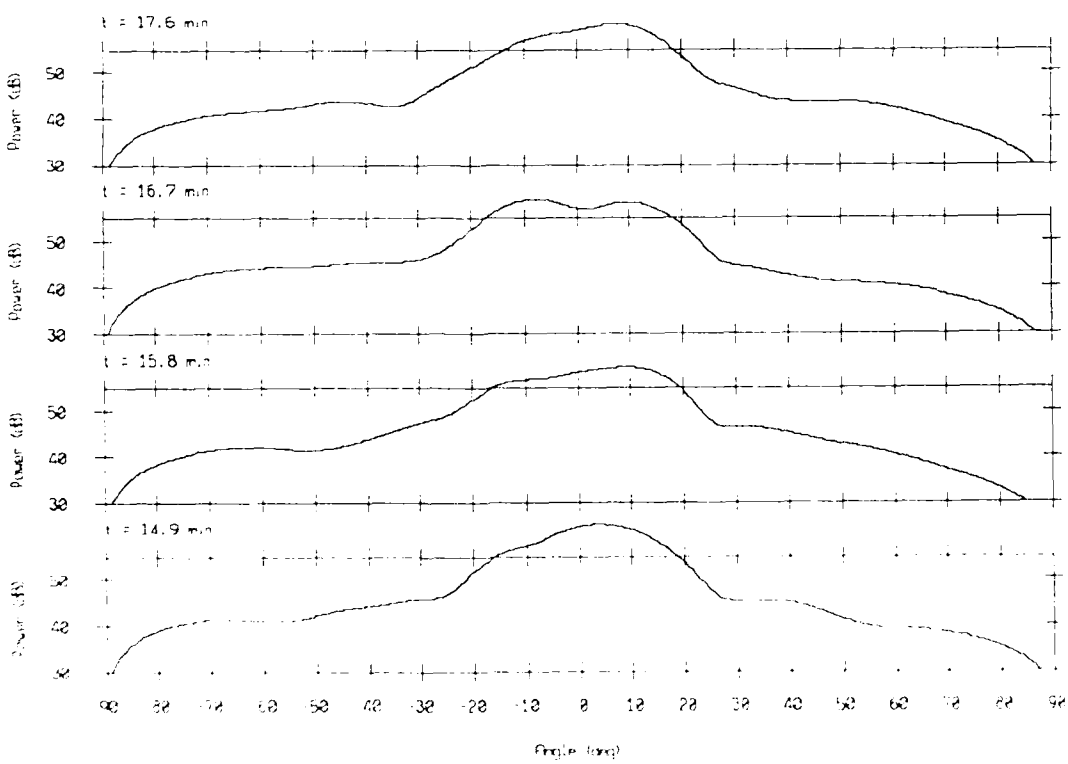

t = 17.6 min
t = 16.7 min
t = 15.8 min
t = 14.9 min
Power (dB)
50
40
30
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90

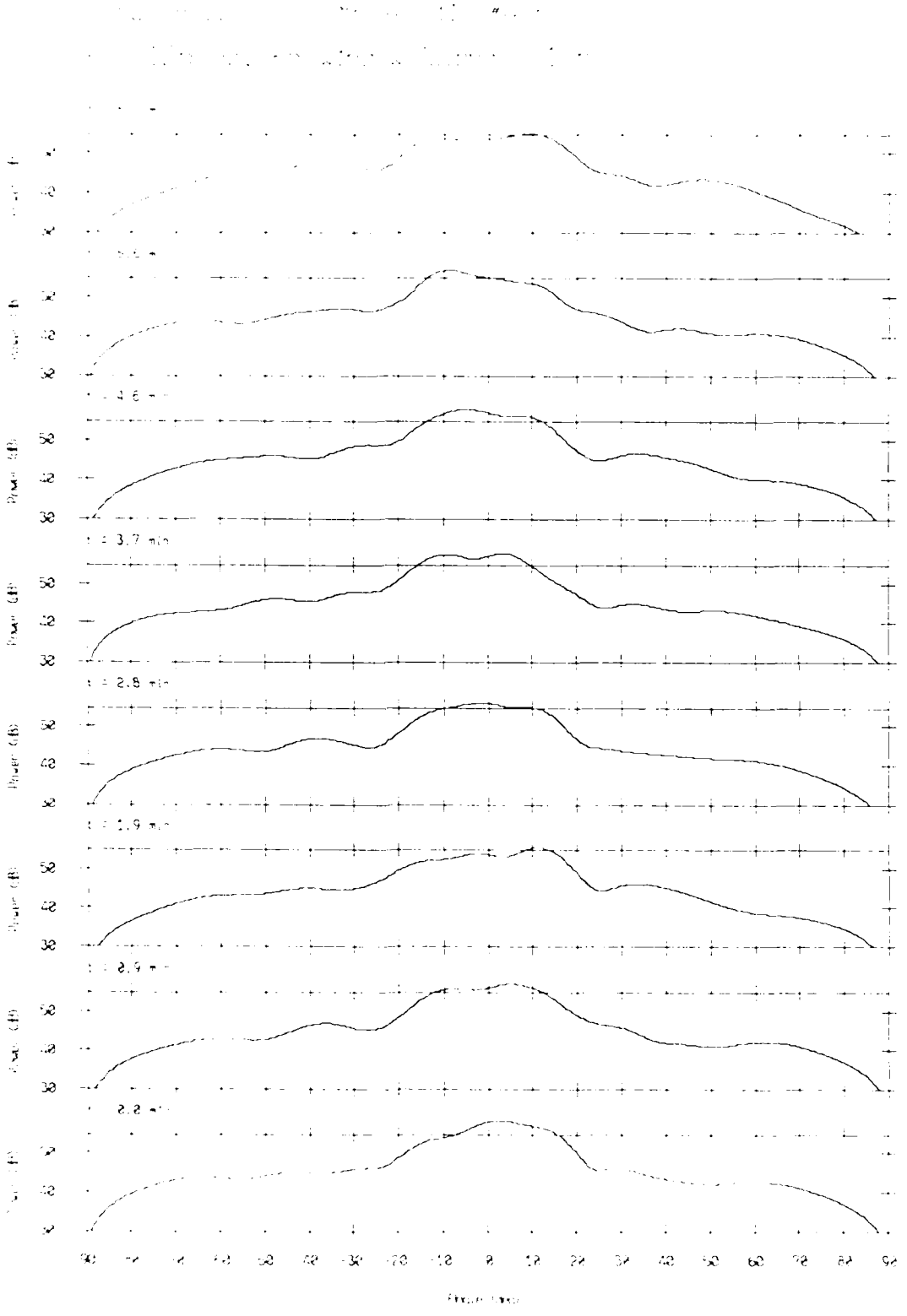

t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
Power (dB)

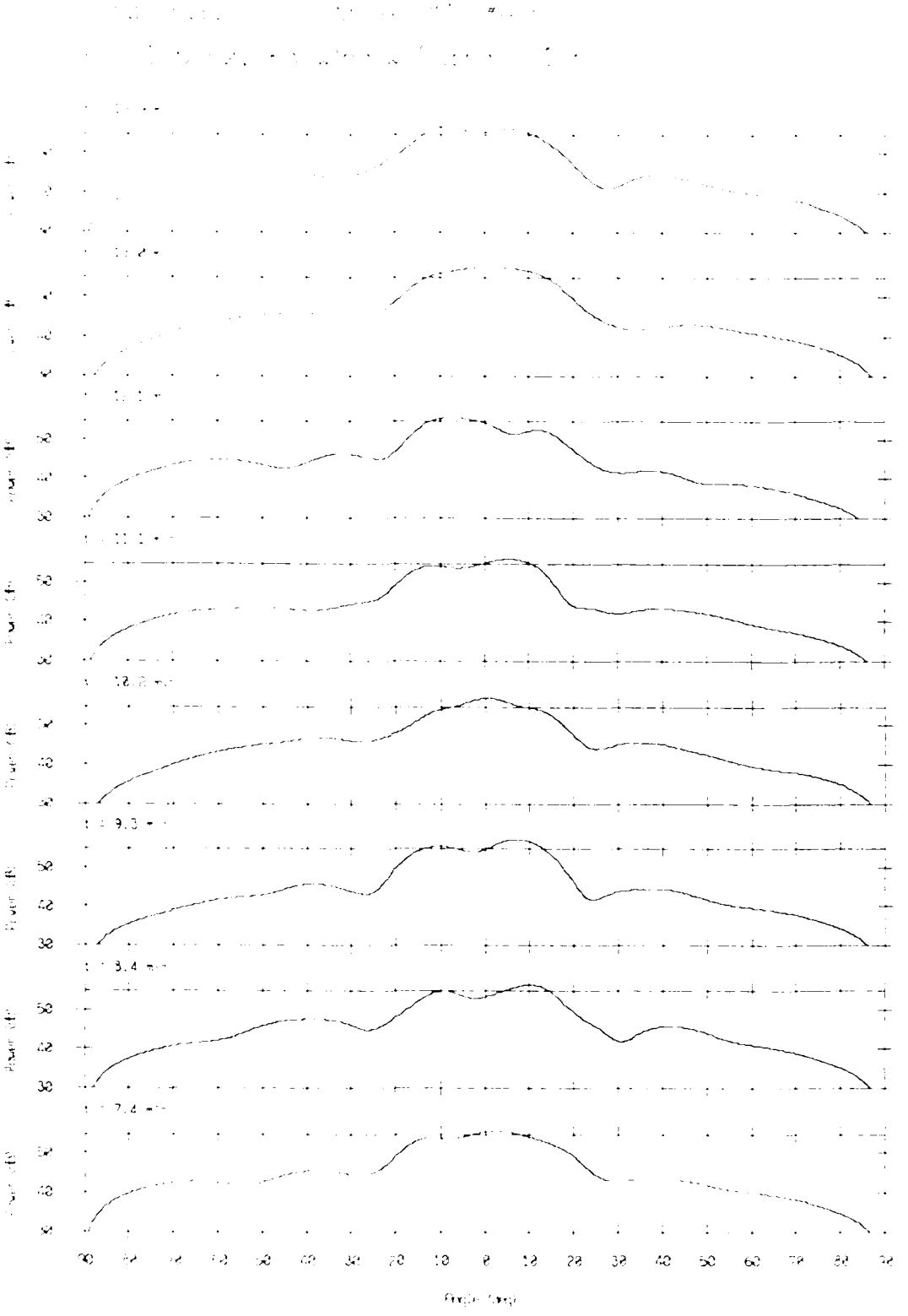

t = 13.9 min
t = 13.0 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
Power (dB)
50
40
30

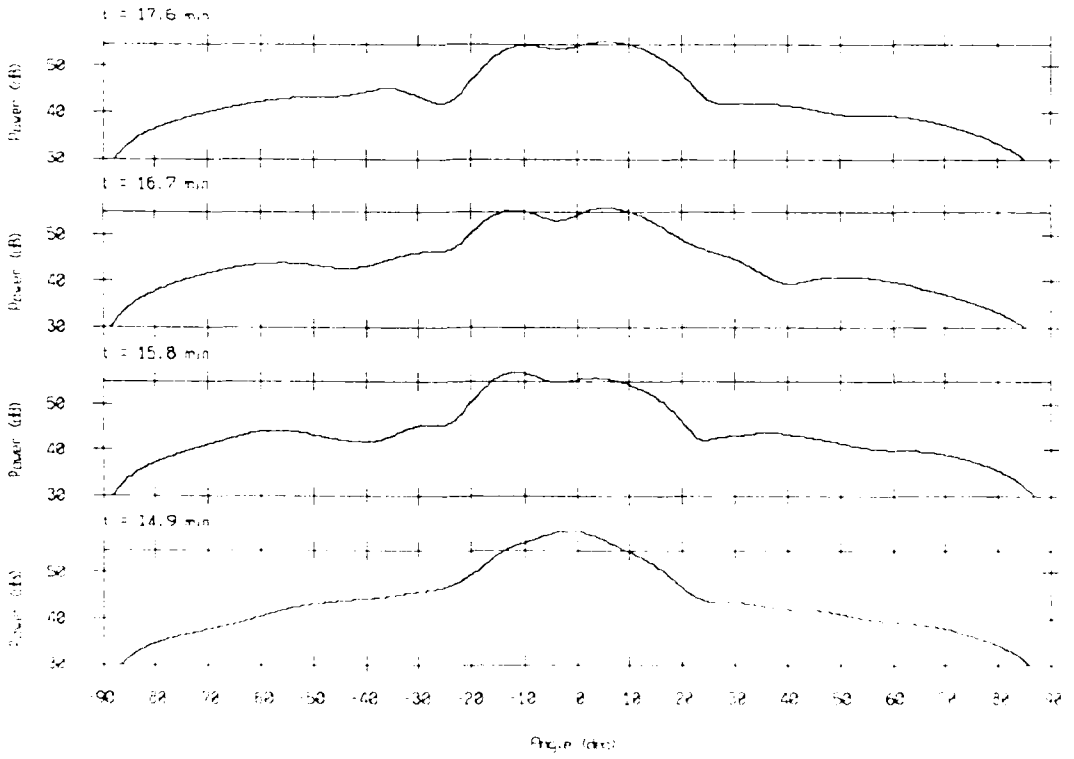
Array Response - 8624.7 Bit #1793

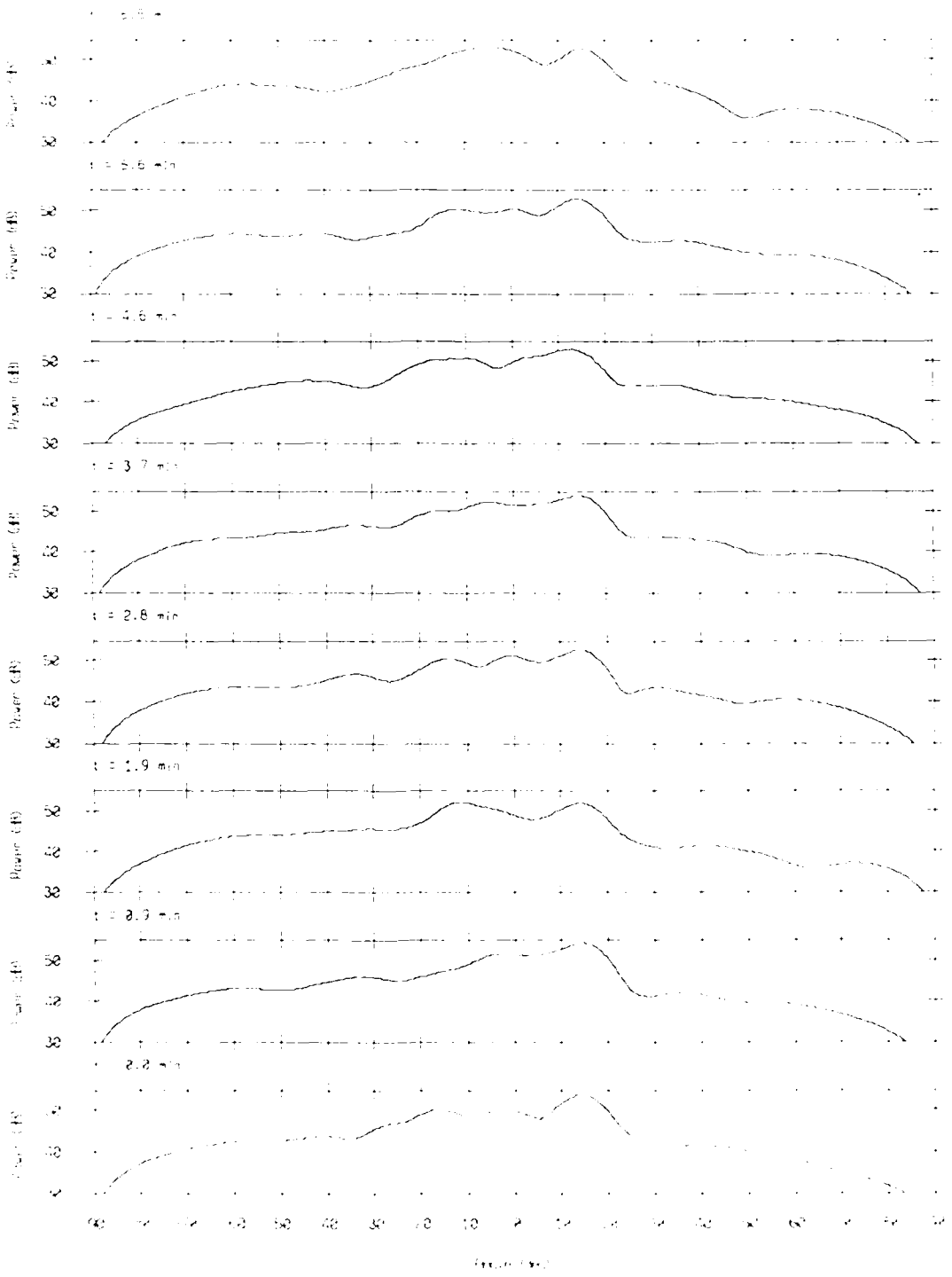
f = 122 +7, -3 Mean Value = 1.5)

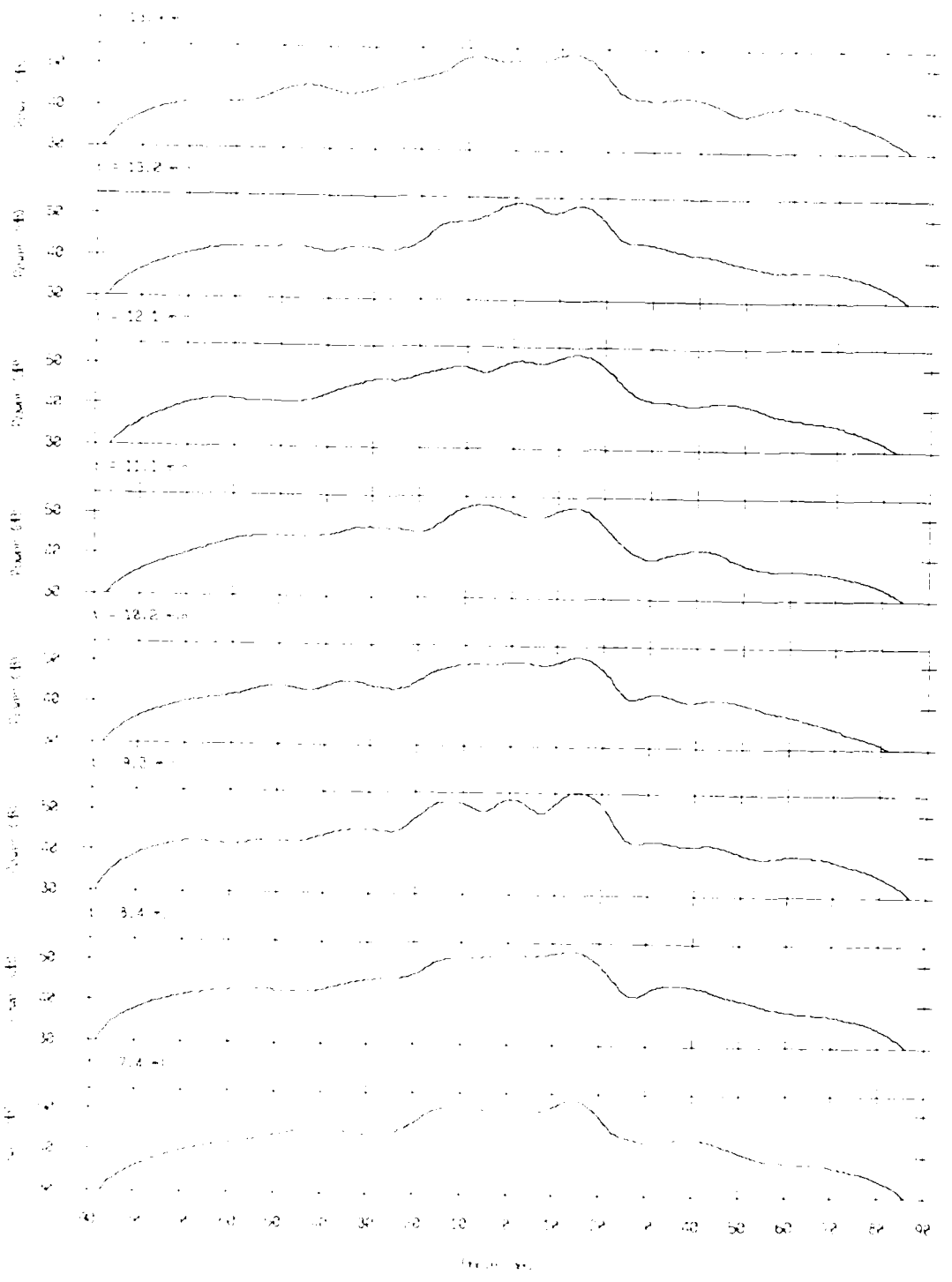


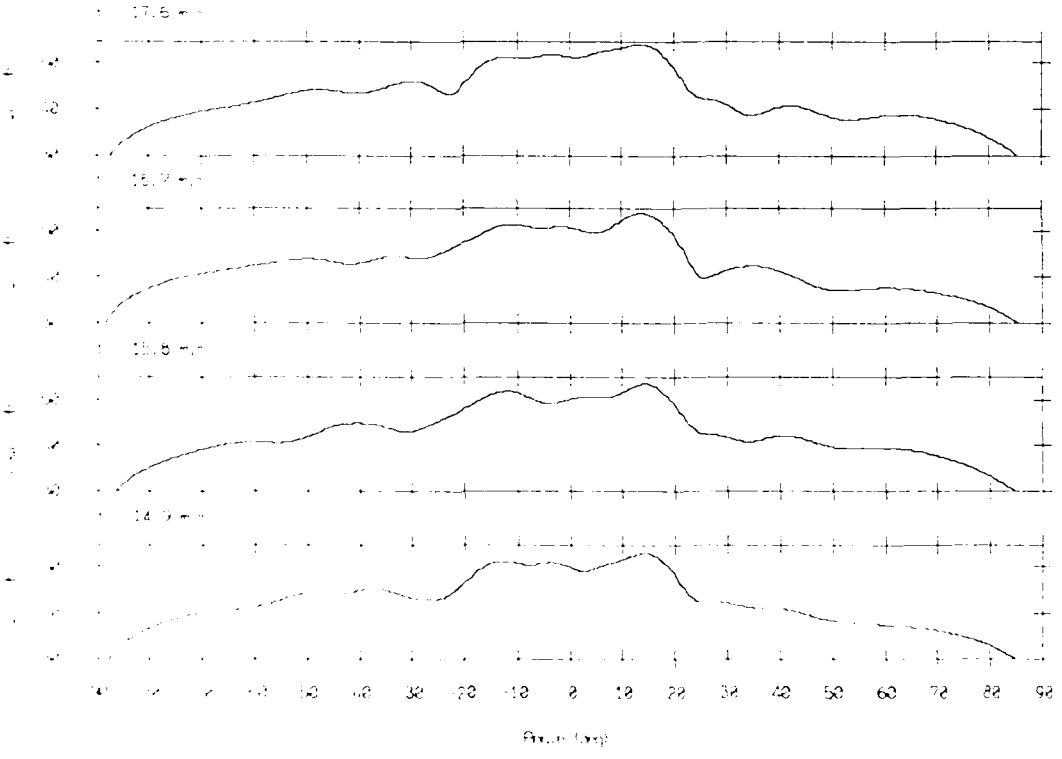


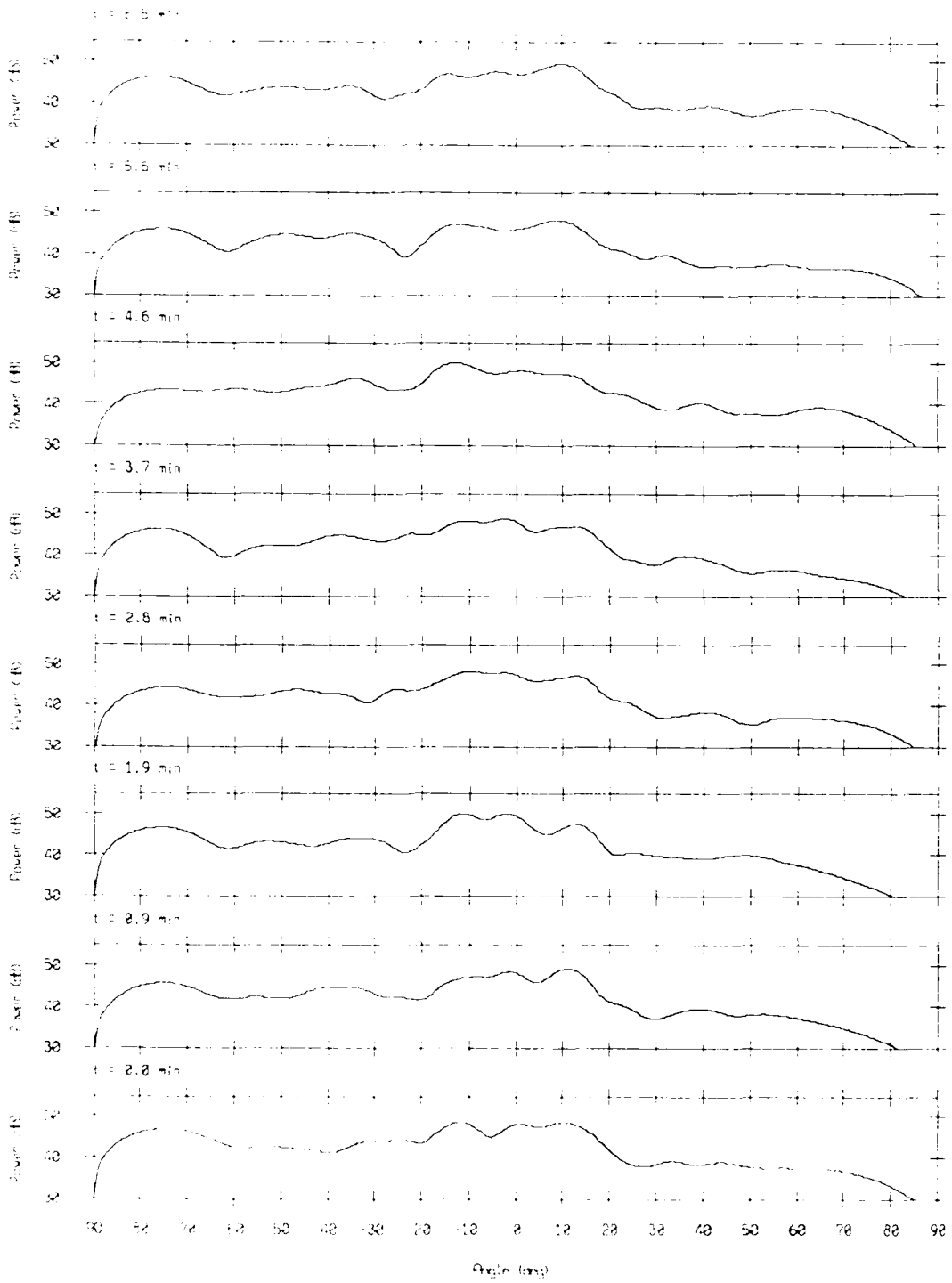


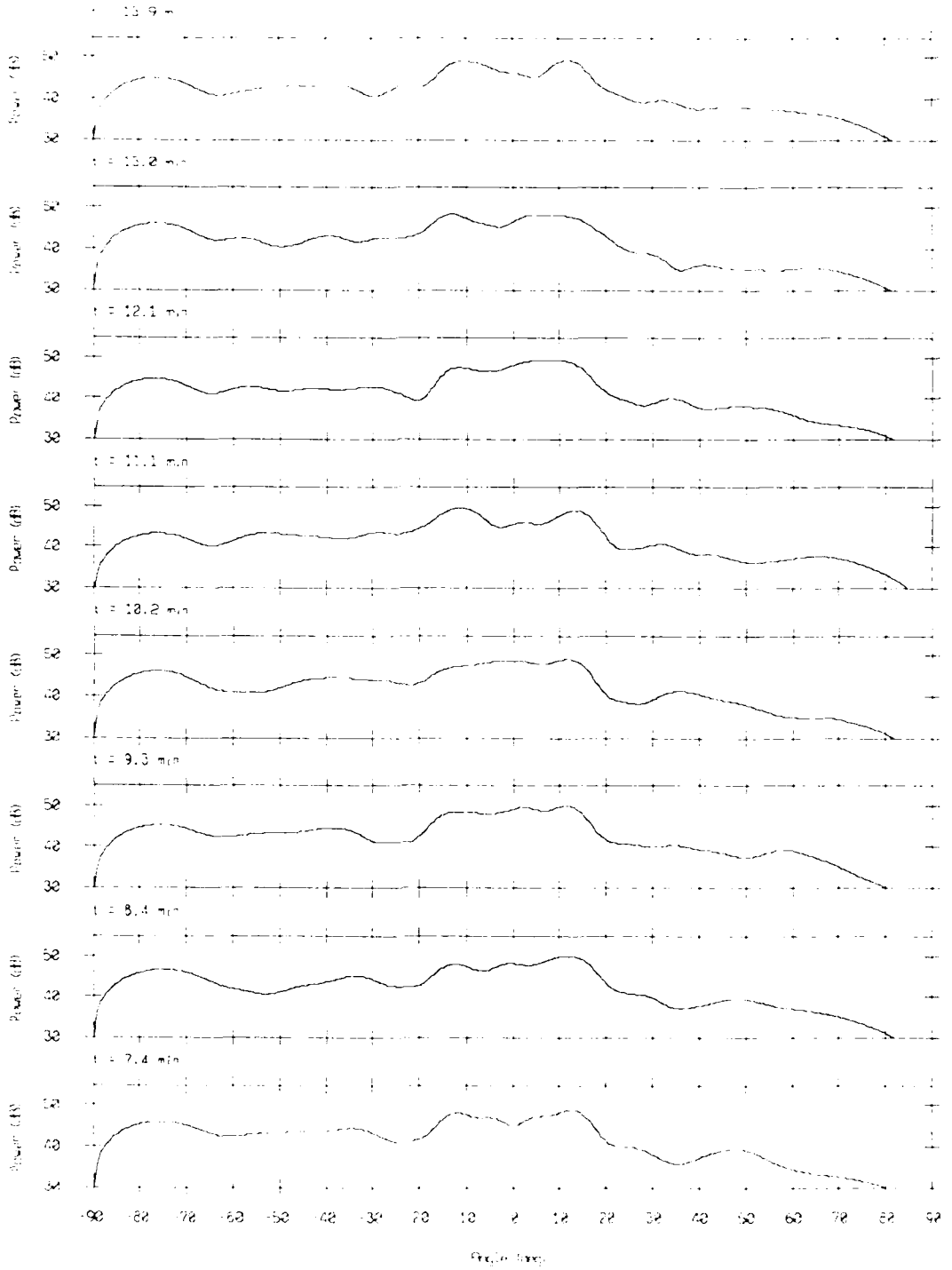

t = 17.6 min
t = 16.7 min
t = 15.8 min
t = 14.9 min
Power (dB)
50
40
30
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90

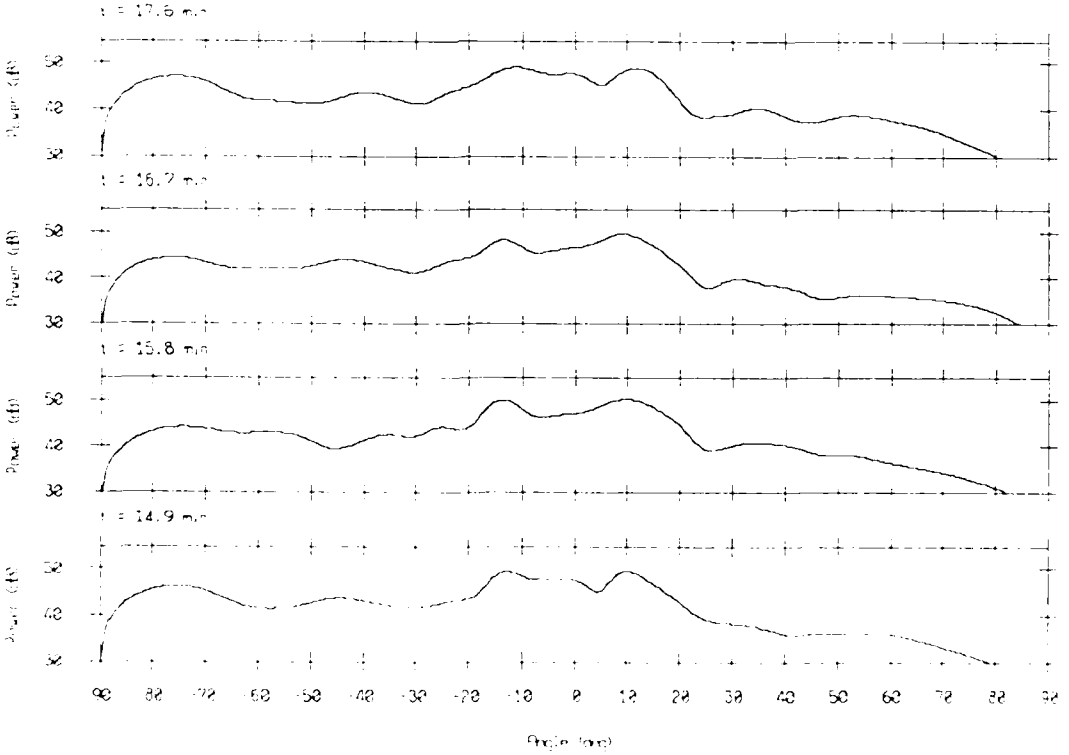

t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
Power (dB)

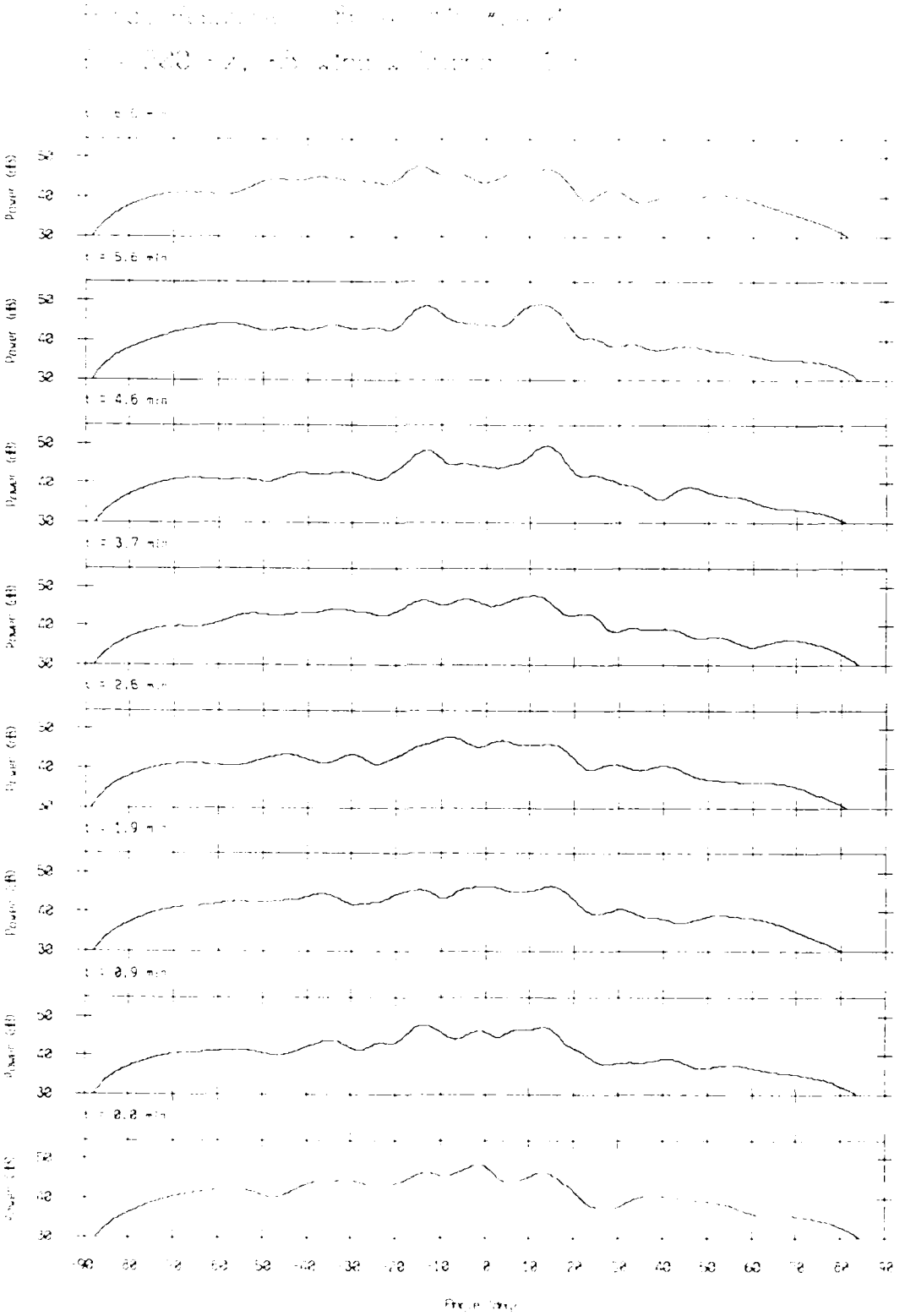


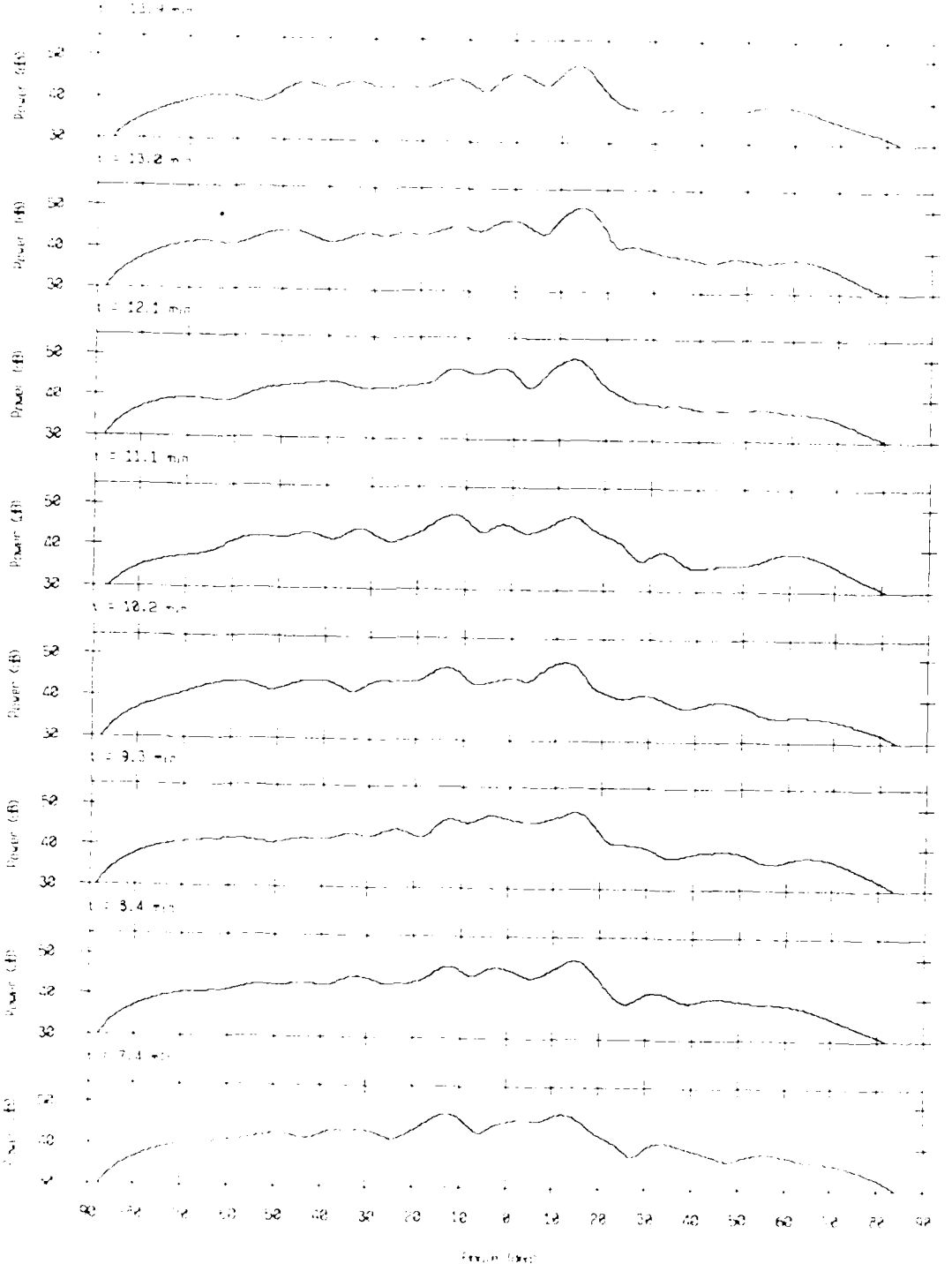



t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
Angle (deg)


t = 13.9 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
Angle (deg)

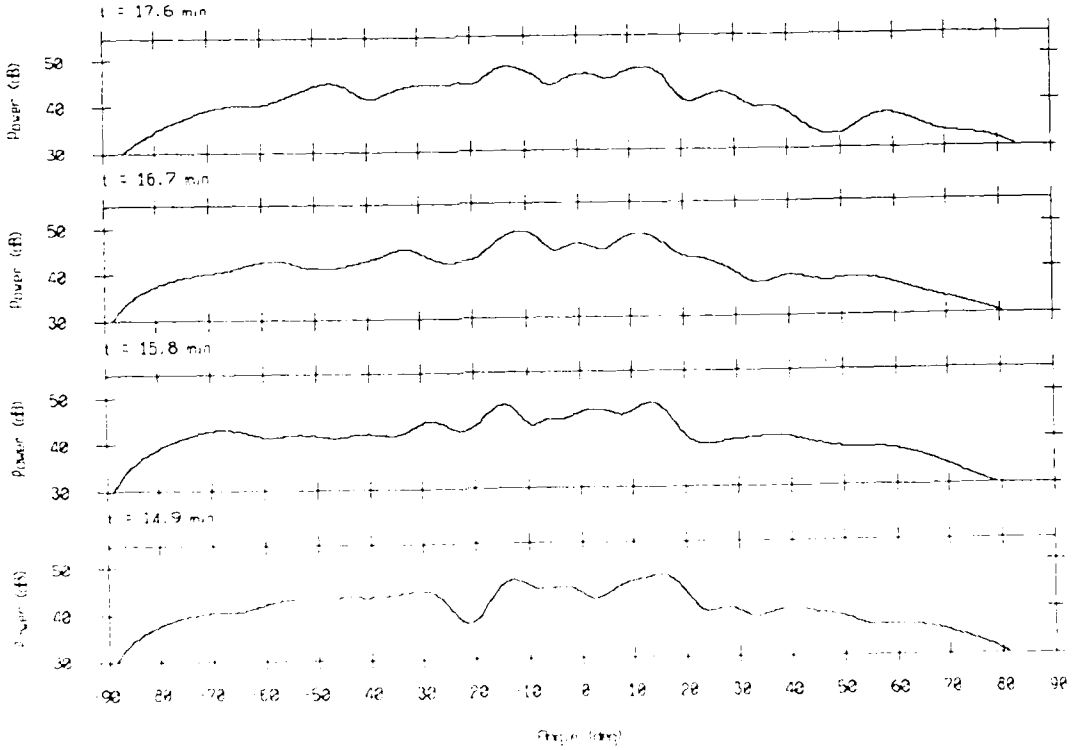

t = 17.6 min
t = 16.7 min
t = 15.8 min
t = 14.9 min
Power (dB)
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

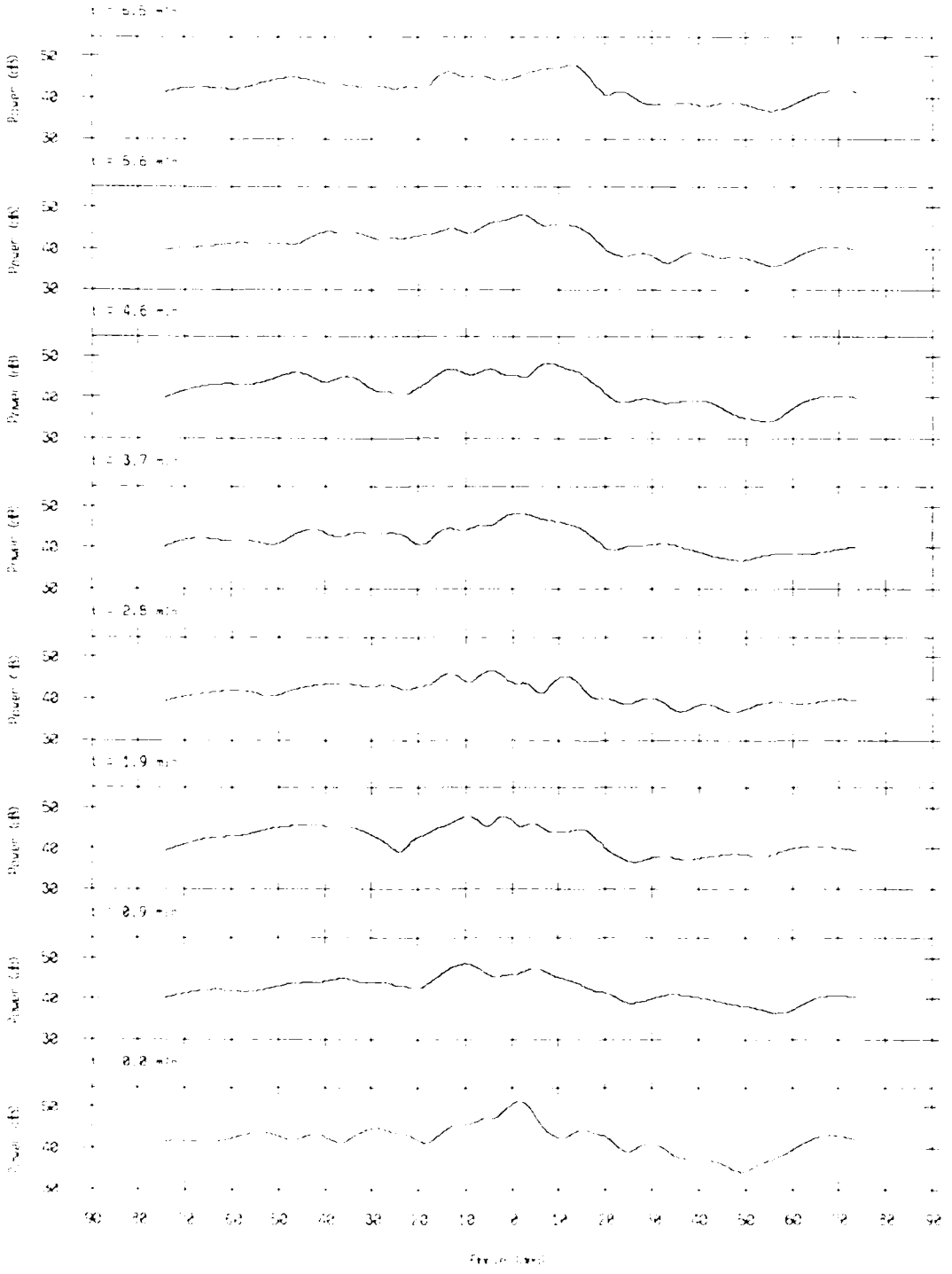

t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
Power (dB)

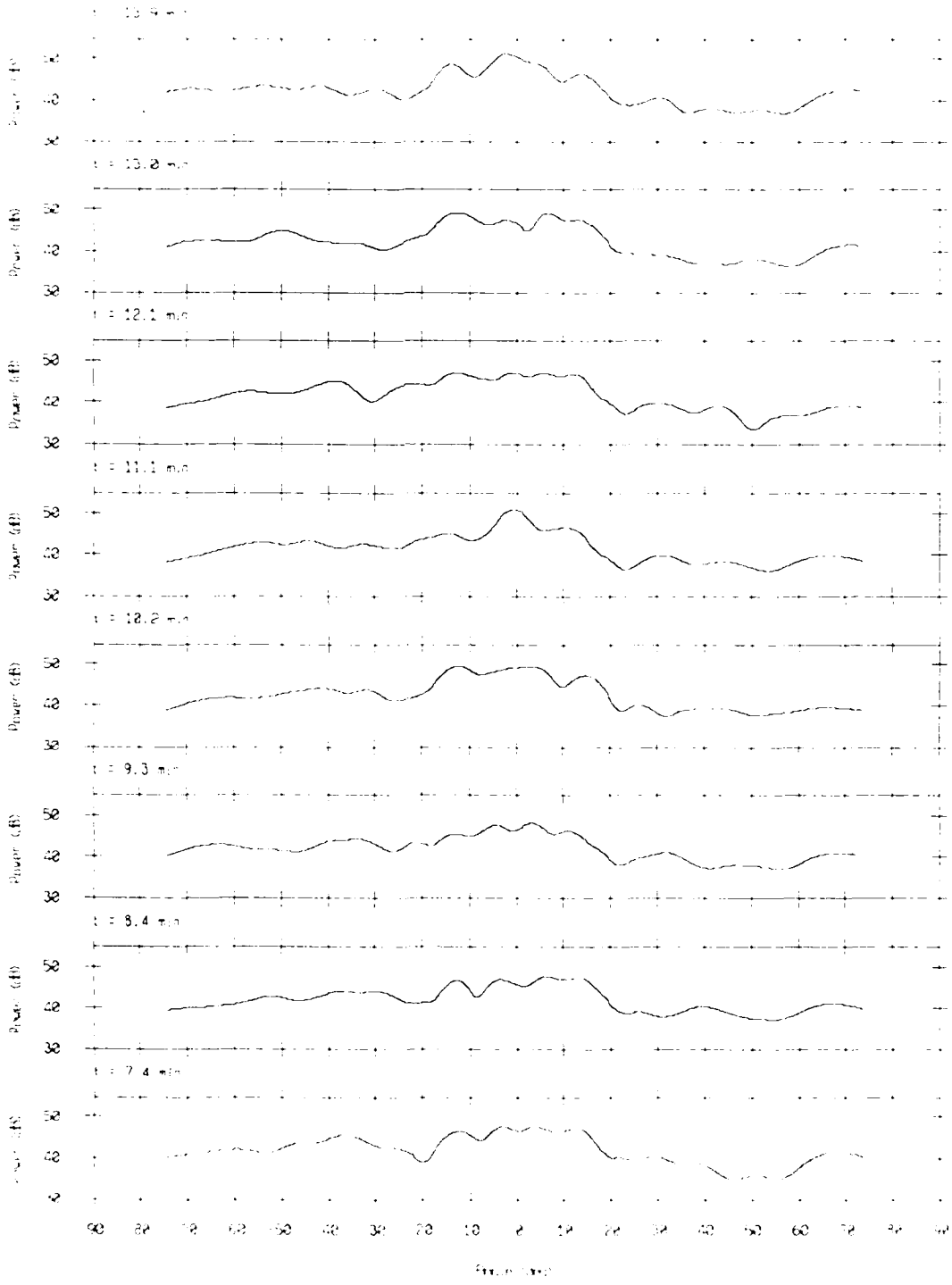


Array Response - 86247 Bin #6492

f = 222 Hz, KB window (alpha = 1.5)

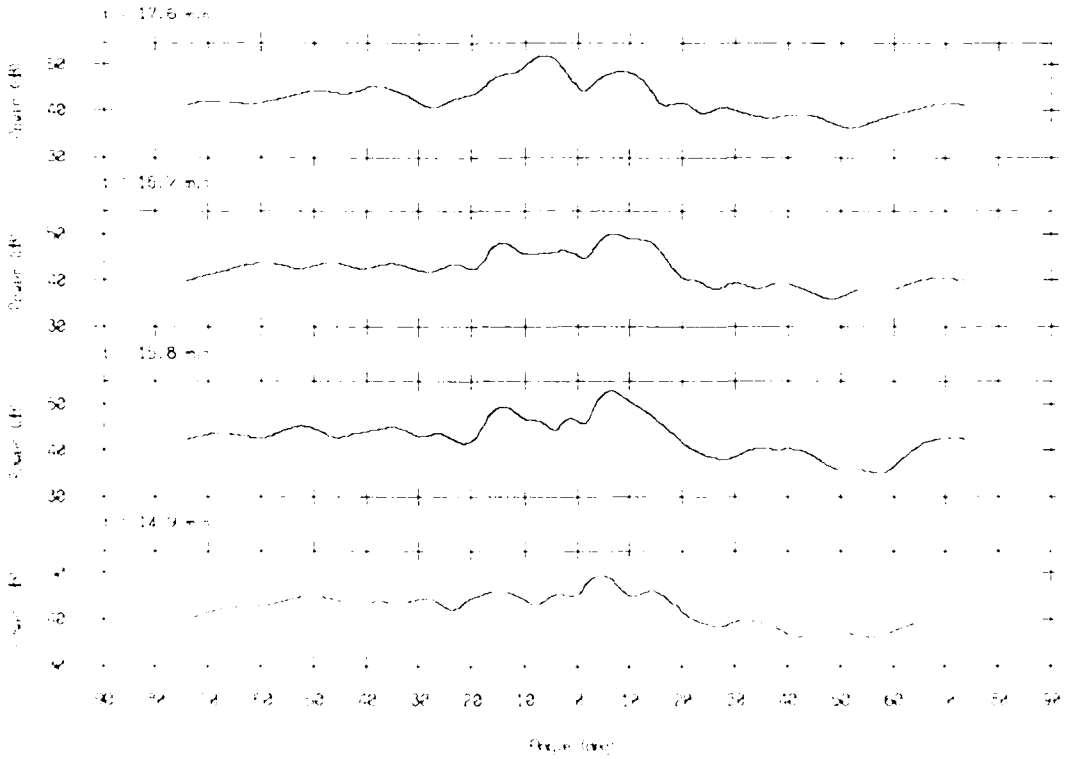


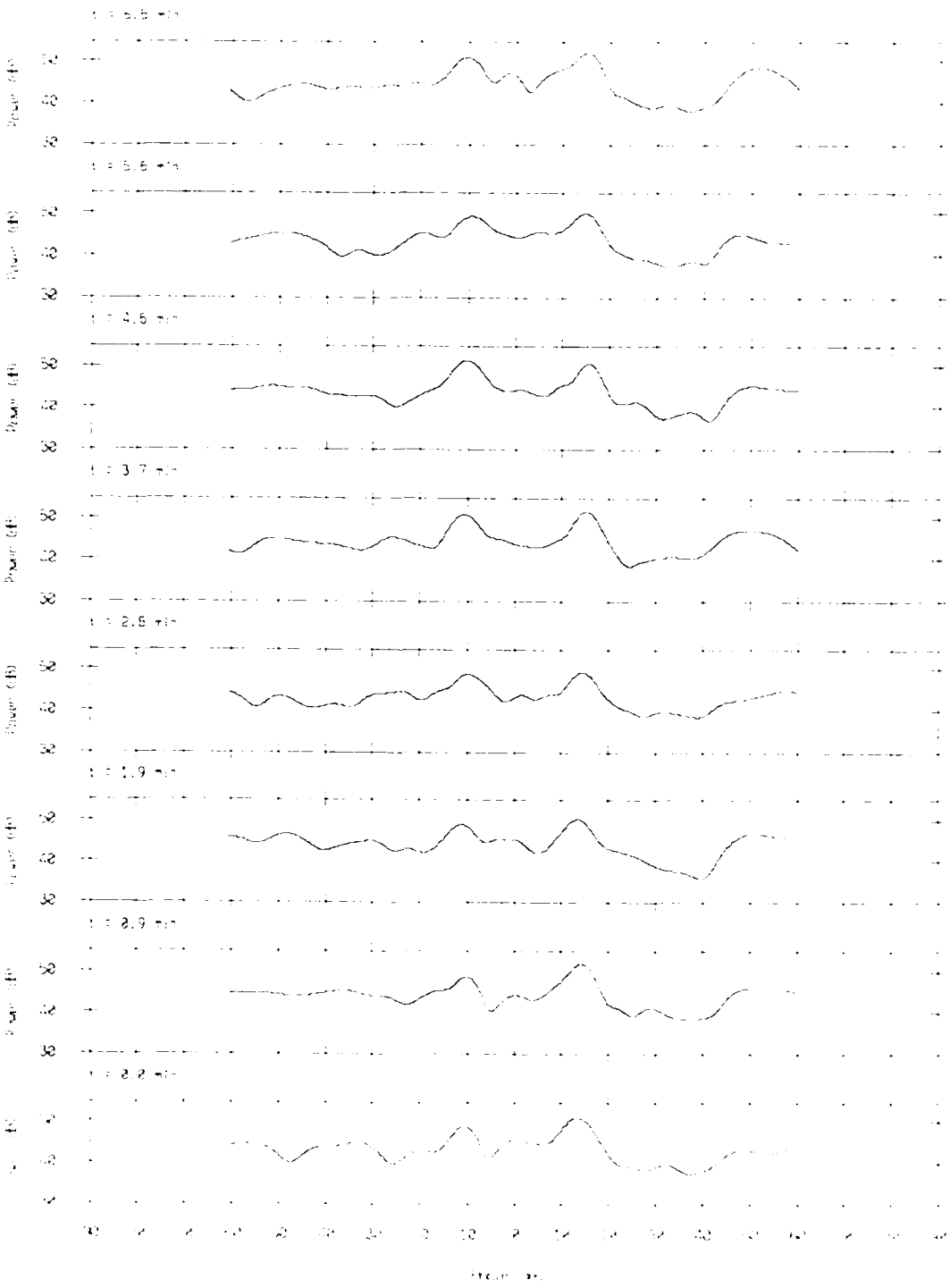


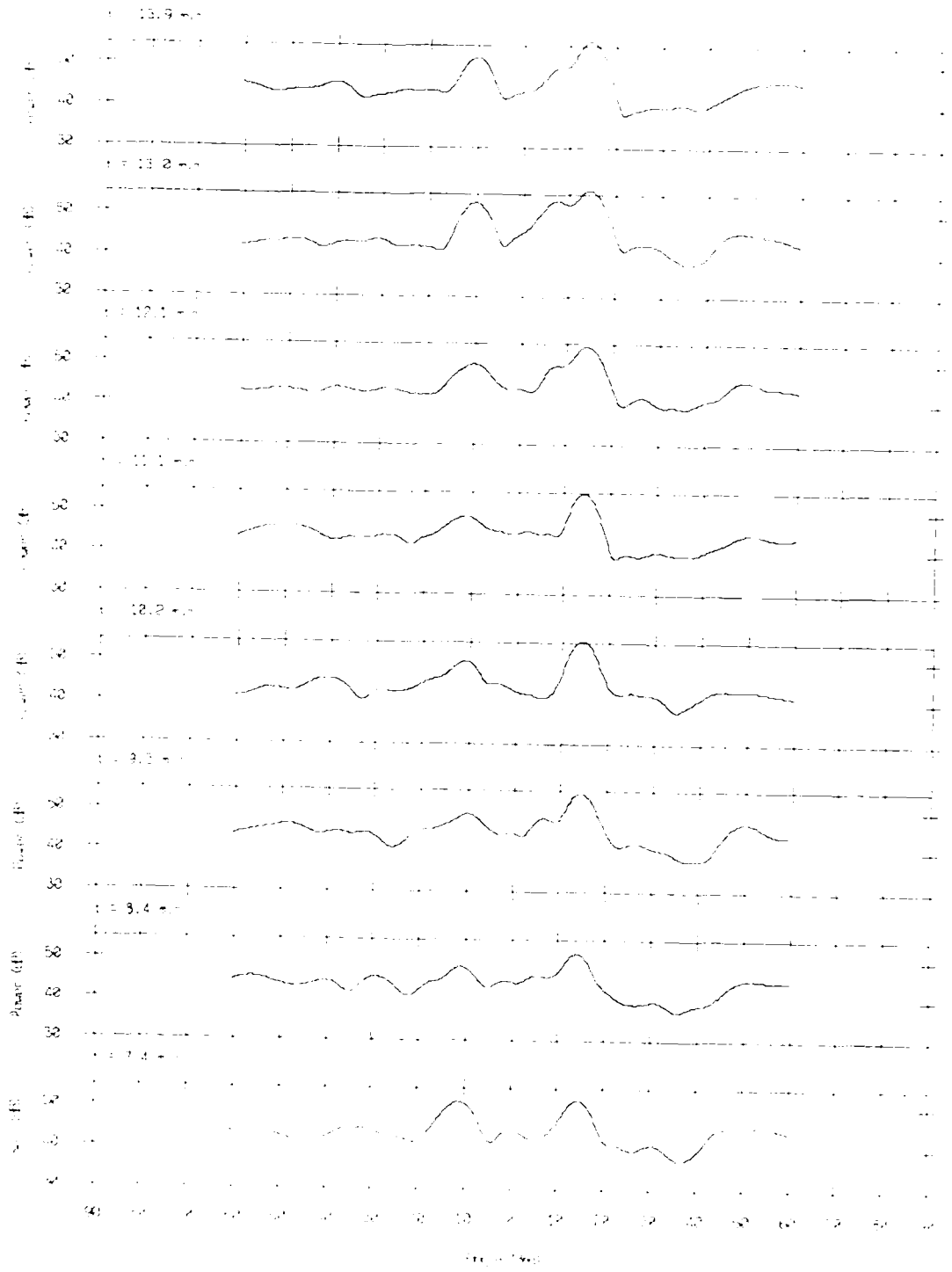


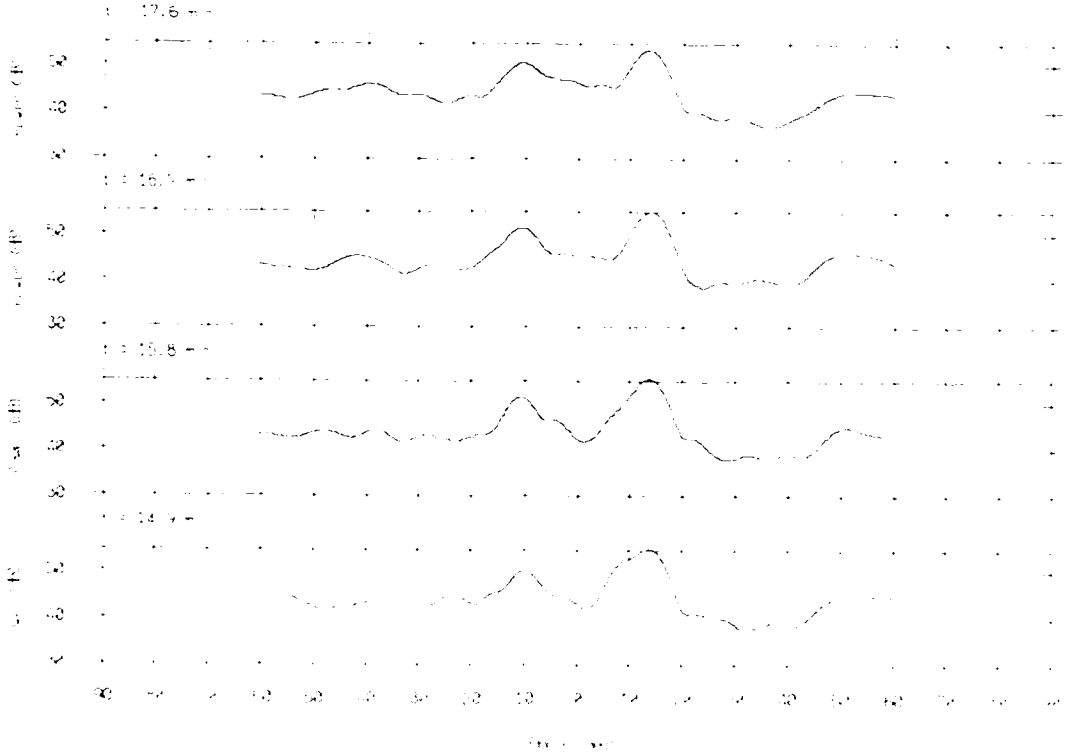
Array Response 86247 Bin #5664

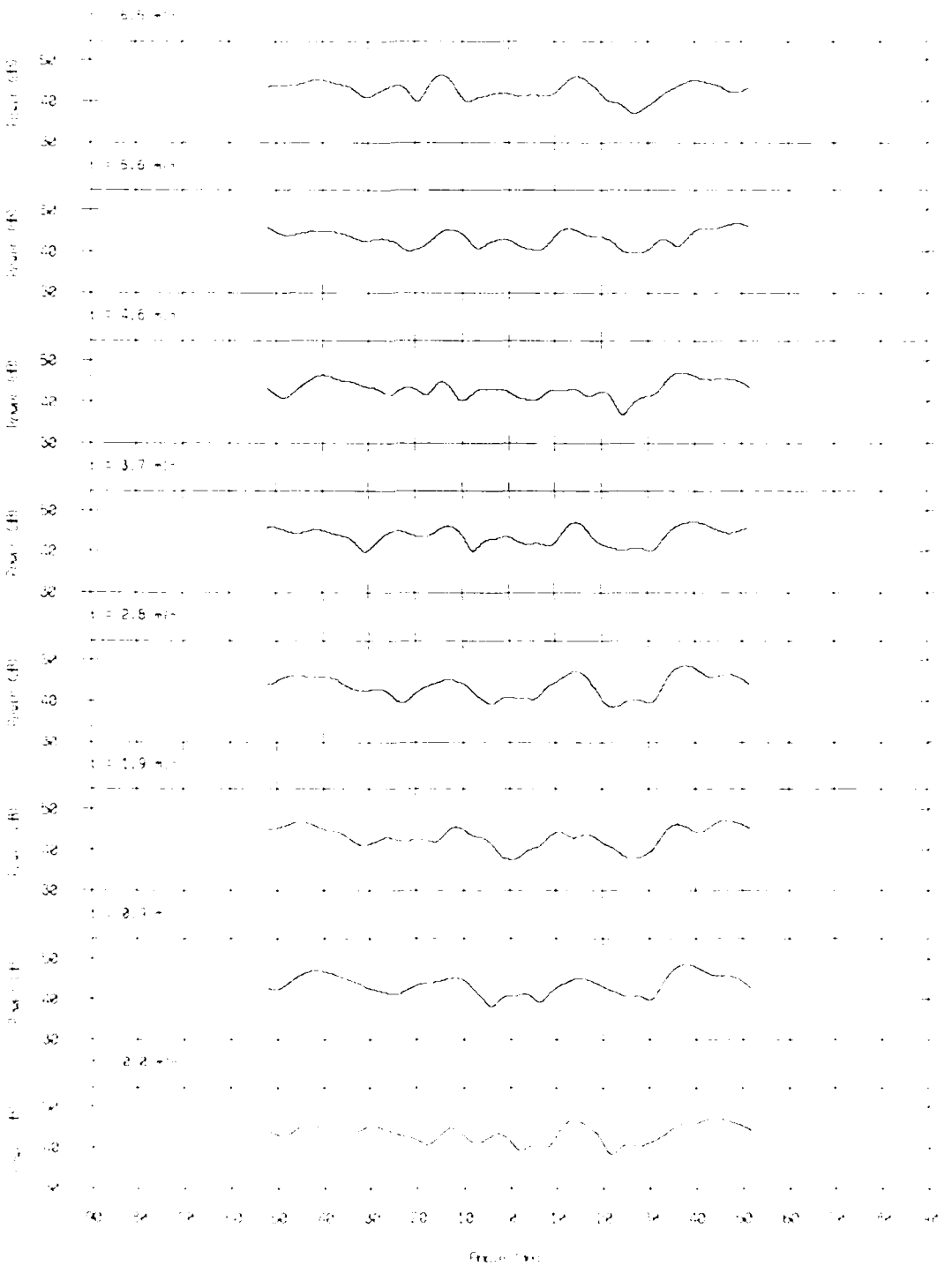
1 - 22.5 Hz, K6 window (clens = 1.5)

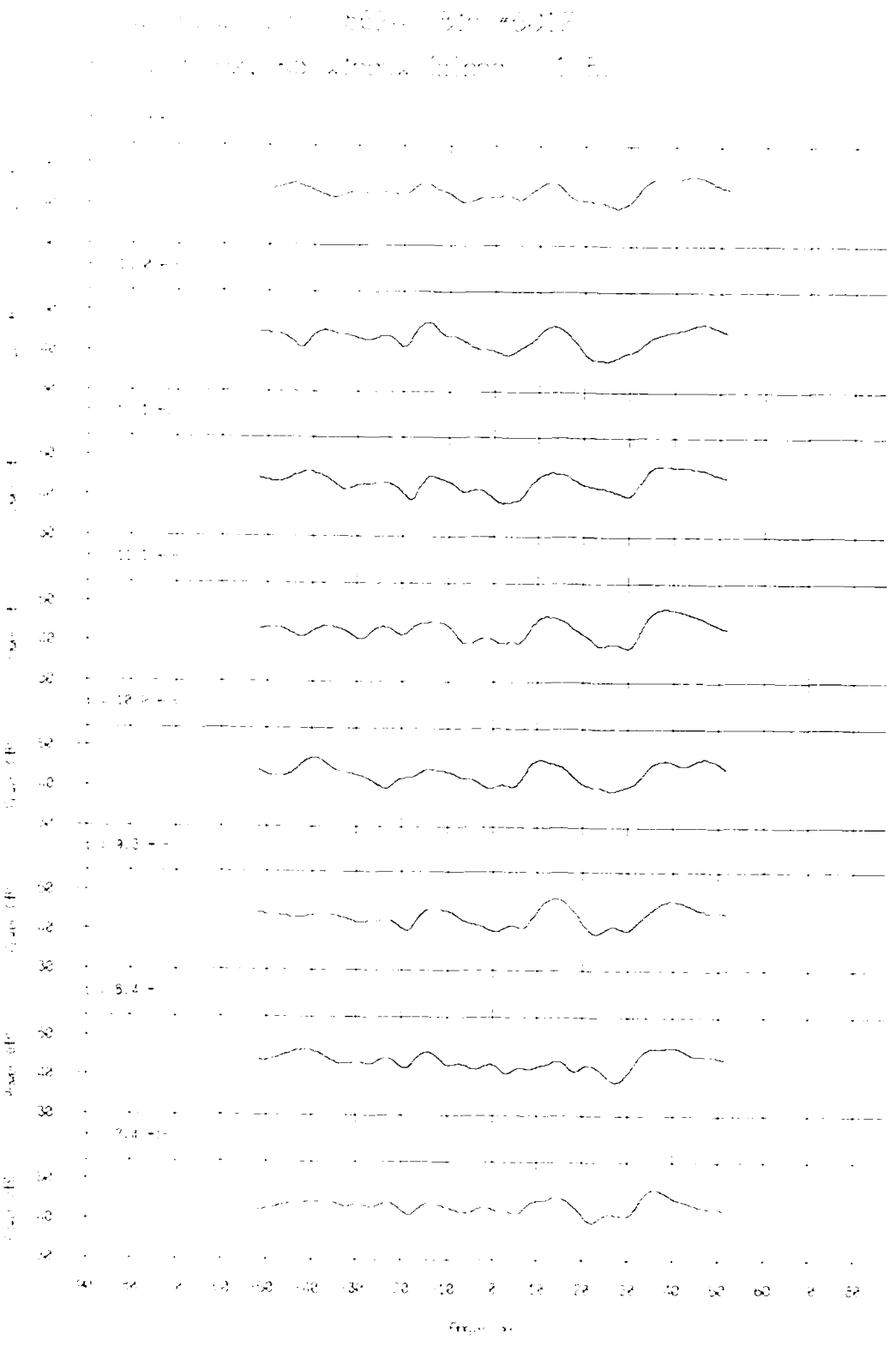






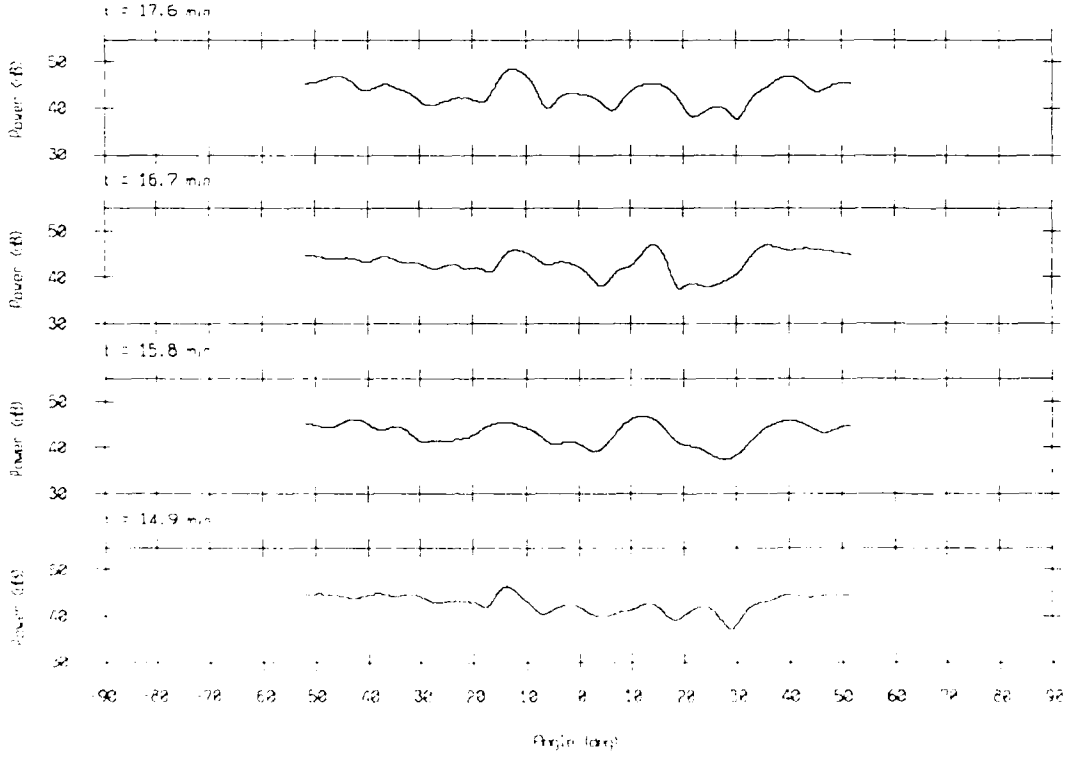


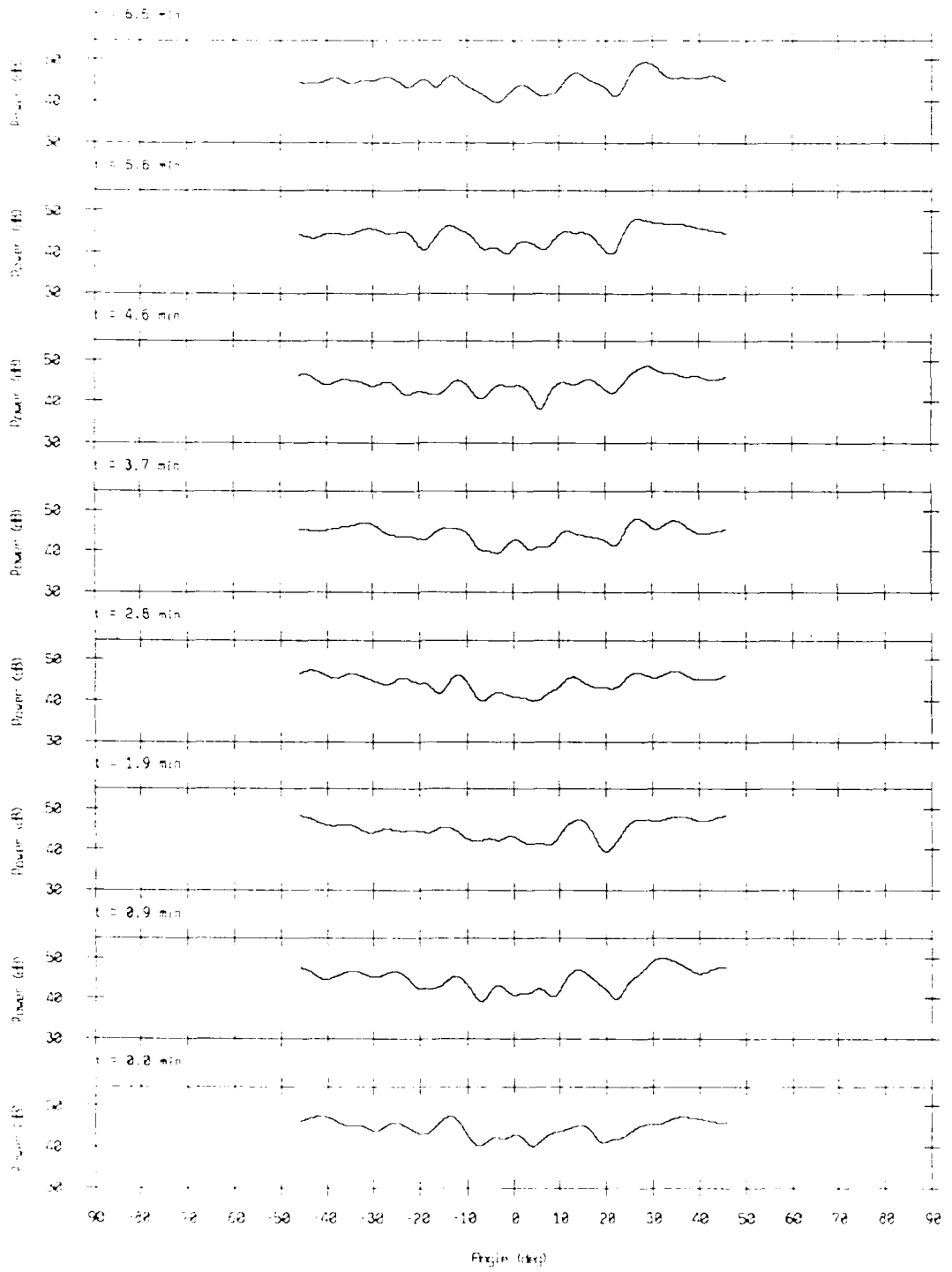


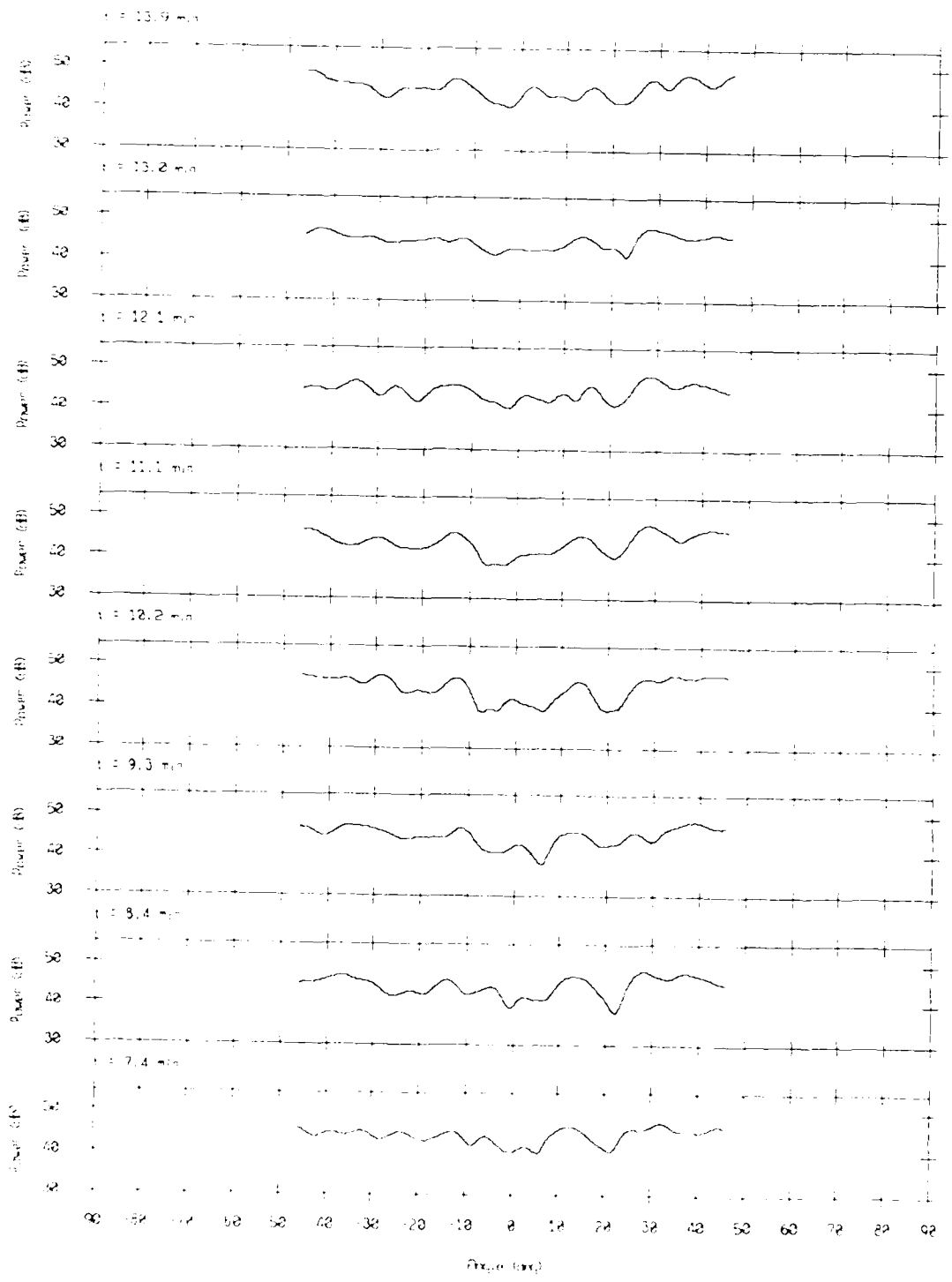


Energy Response - 86247 Bin #6012

f = 275 Hz, KB window (alpha = 1.5)

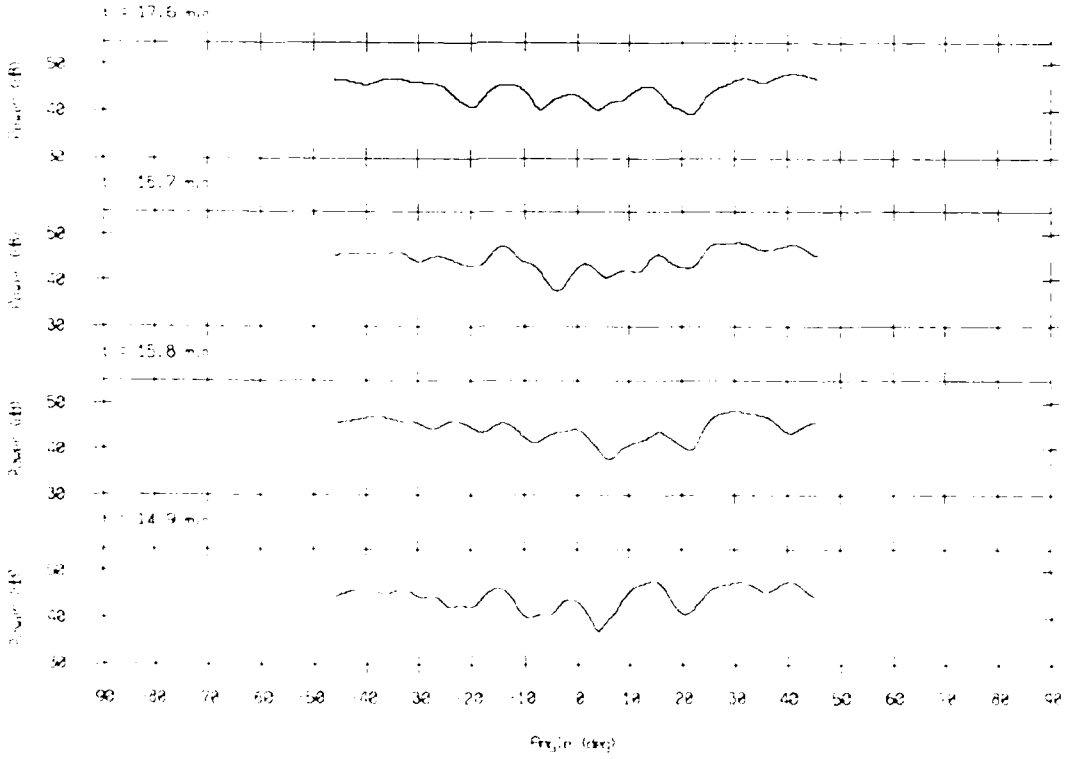



t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

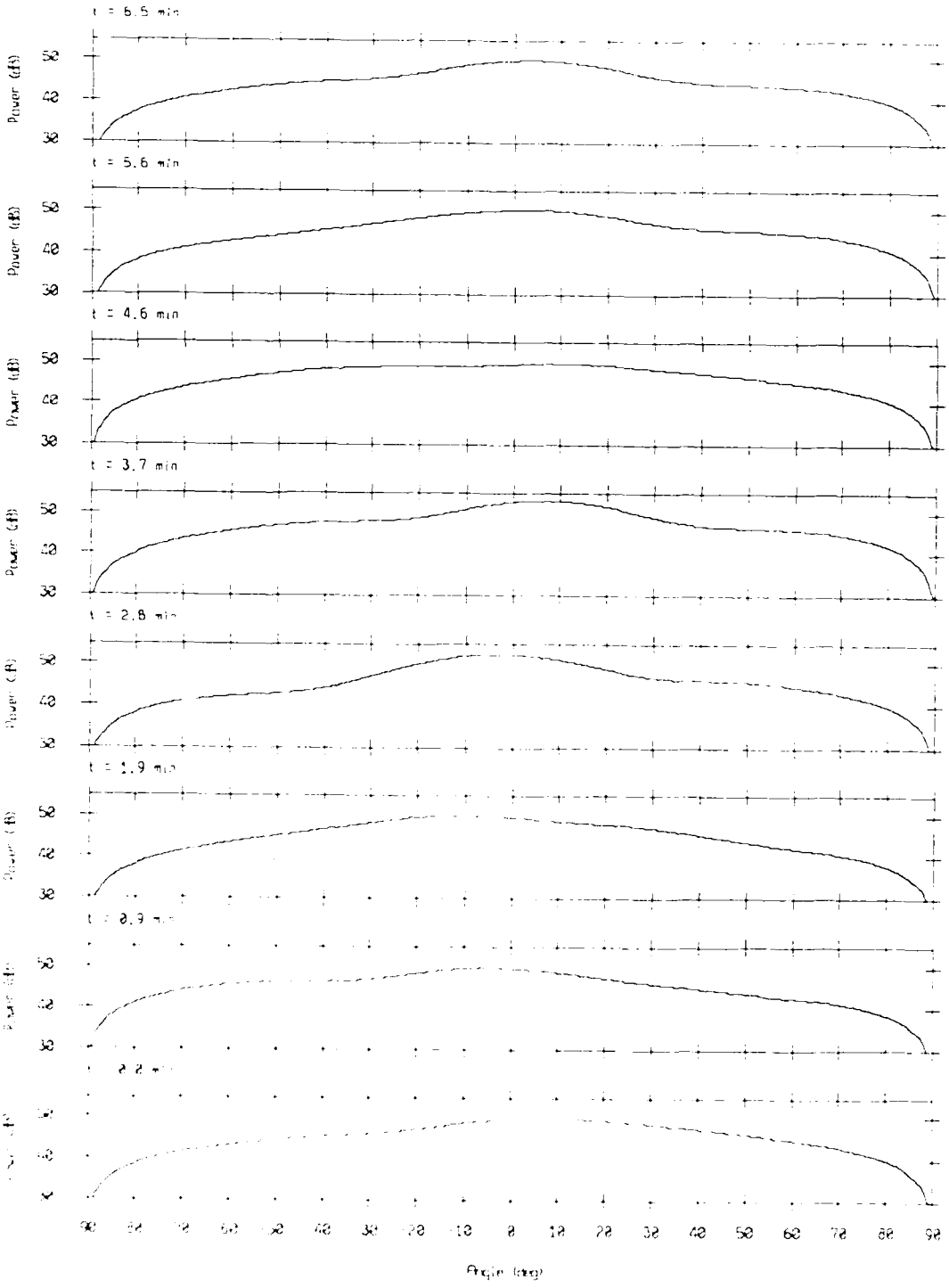

Array Response - 86247 Bin #6186
f = 388 Hz, K5 window (alpha = 1.5)
t = 13.9 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
Angle (deg)

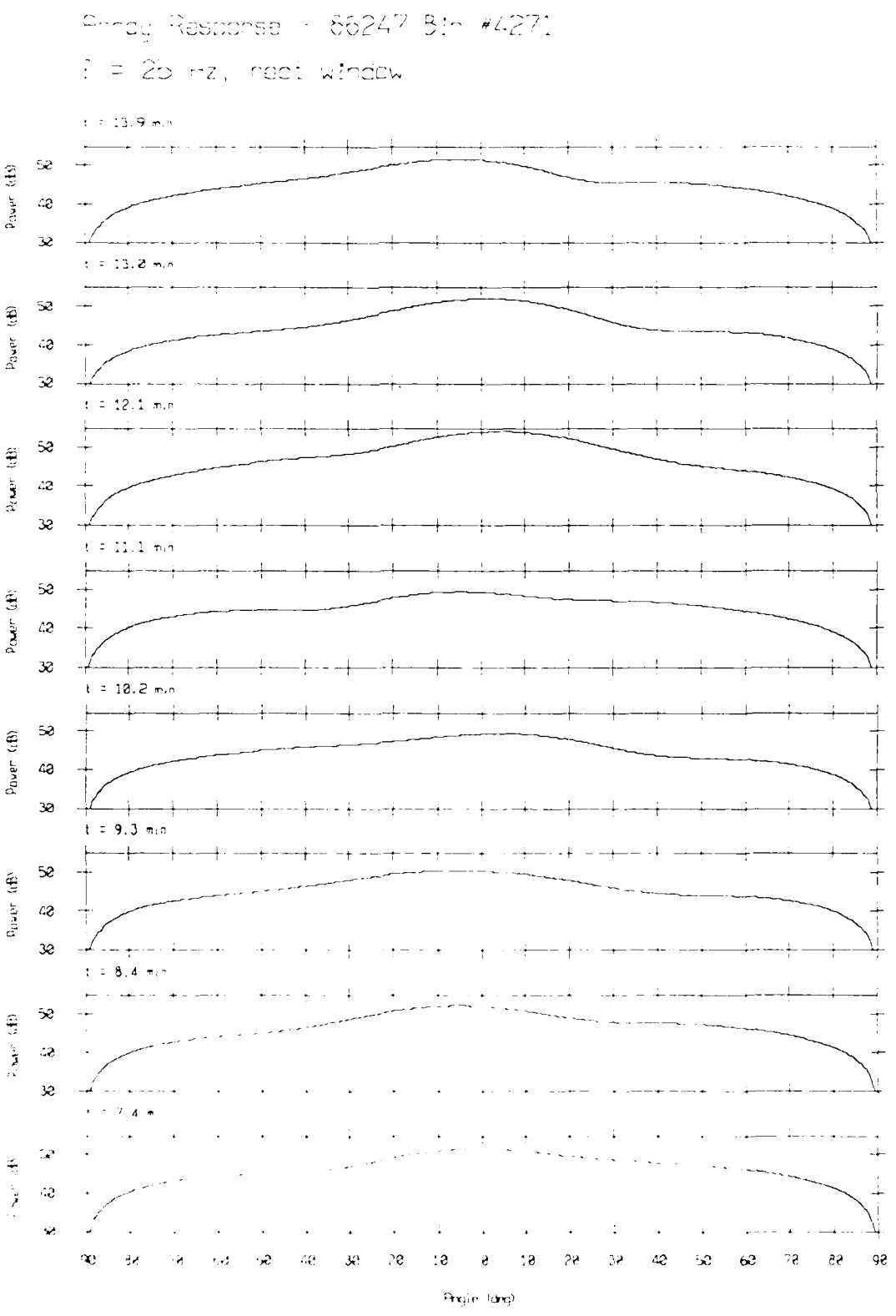
Array Response - 88247 Bin #6186

f = 388 Hz, KB window (alpha = 1.5)



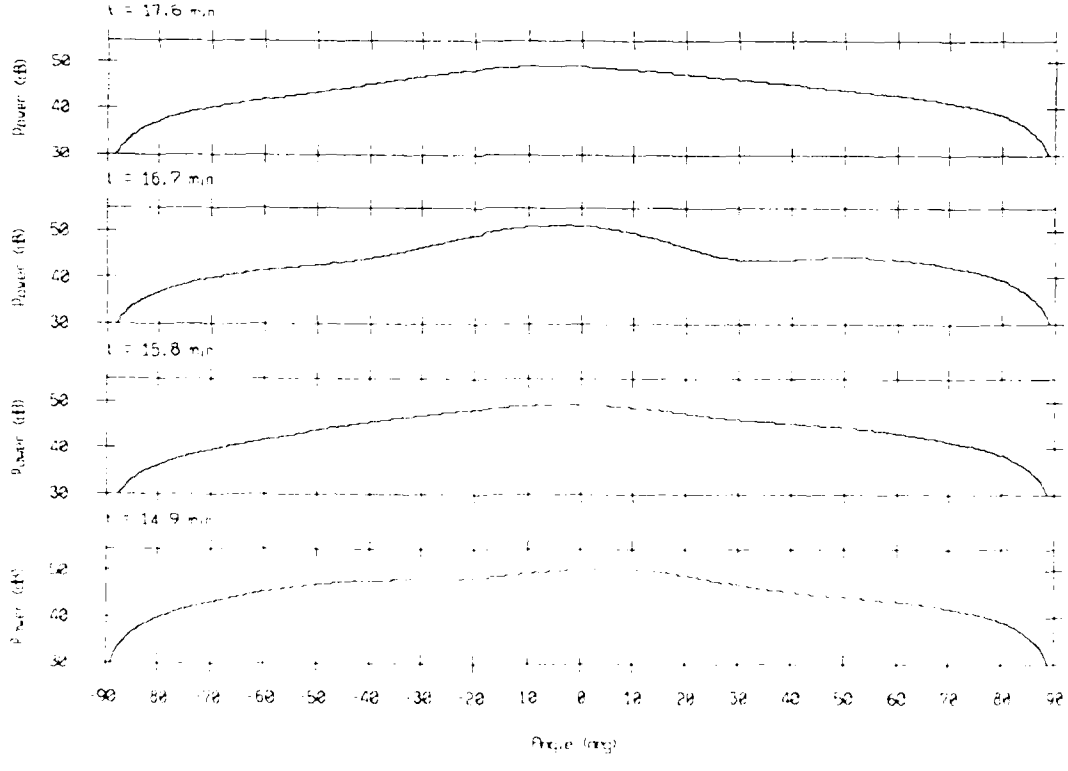
VII. Array Response: Panels, Rect Window.

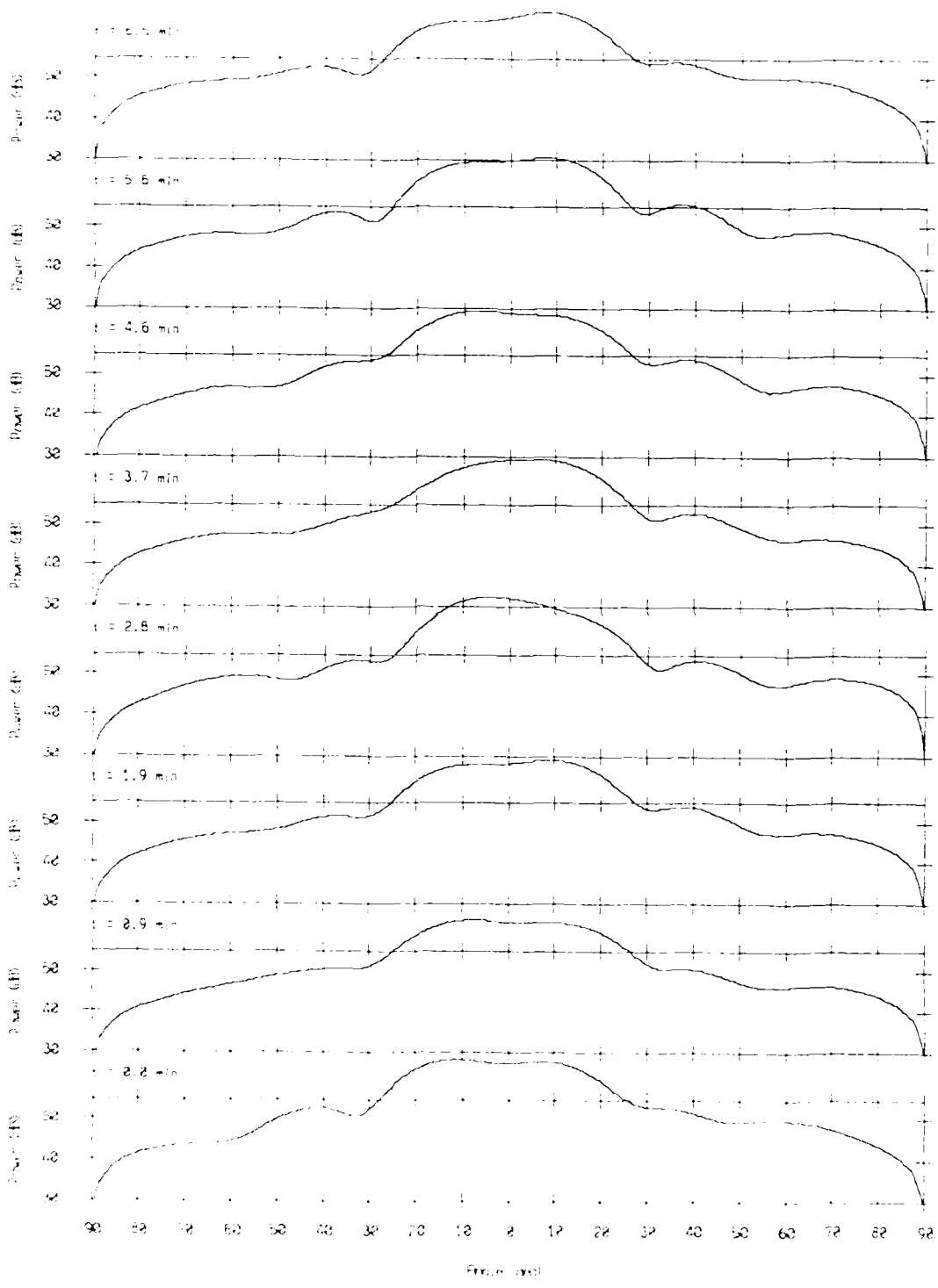

Array Response - 88247 Bin #127
f = 25 Hz, rect window
t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
Power (dB)
50
40
30
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
Angle (deg)

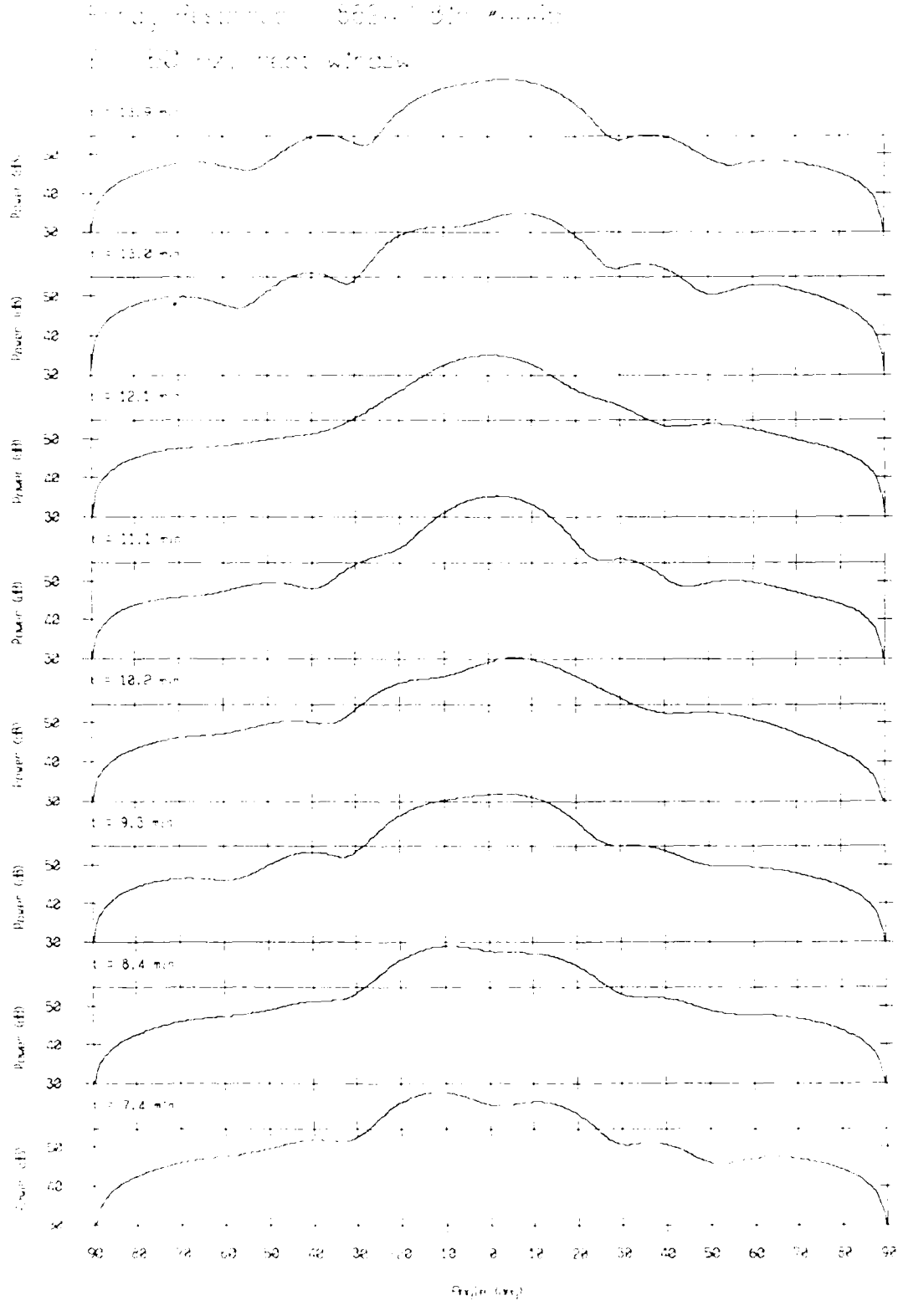

Array Response - 86247 Bin #4271
f = 25 Hz, rect window
t = 13.9 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
Power (dB)
Angle (deg)

Array Response - 8624.7 Hz #427

f = 25 Hz, rect window

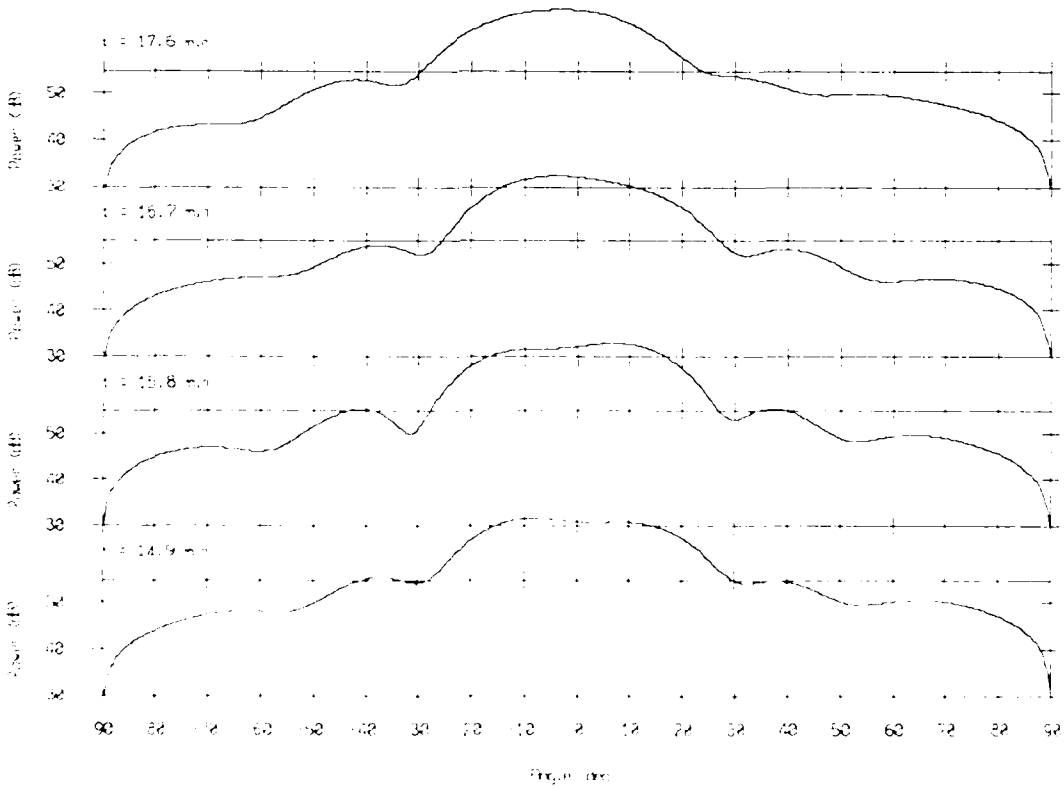


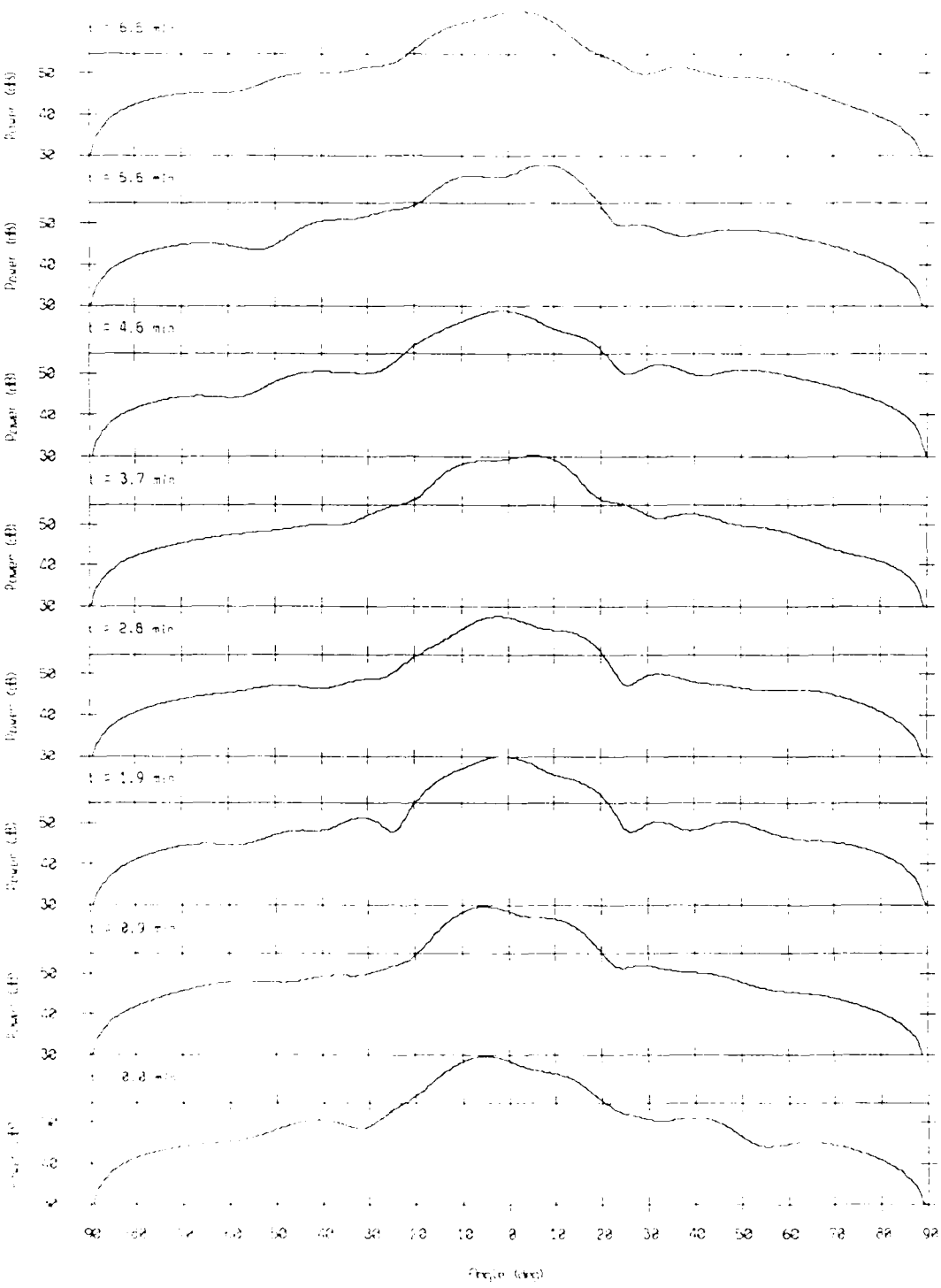

t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
Power (dB)

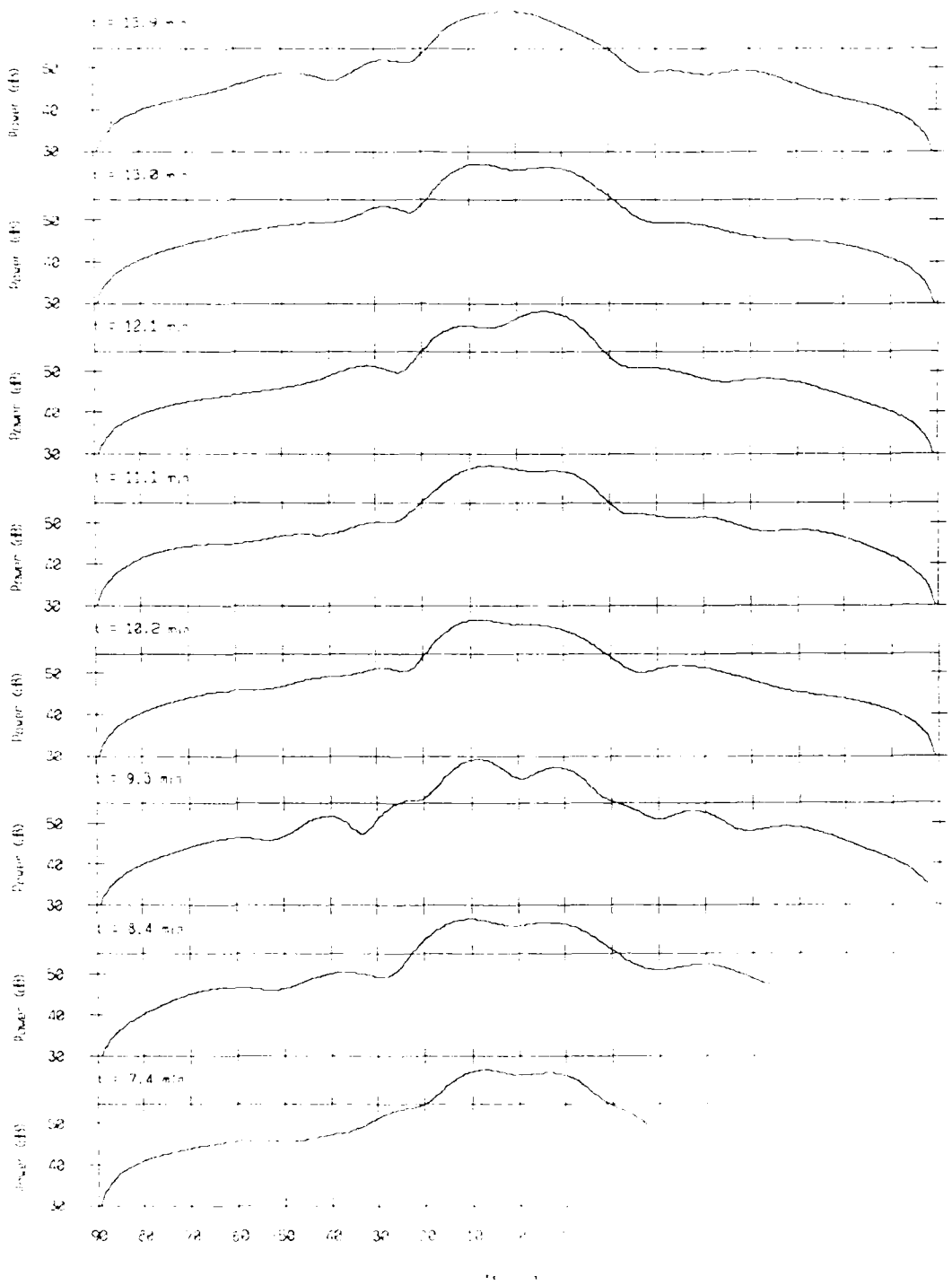


Array Response - 88247 Bin #4445

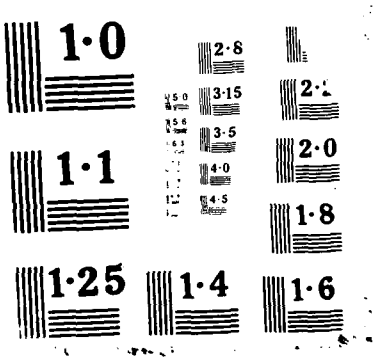
f = 50 Hz, rect window




t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
Power (dB)

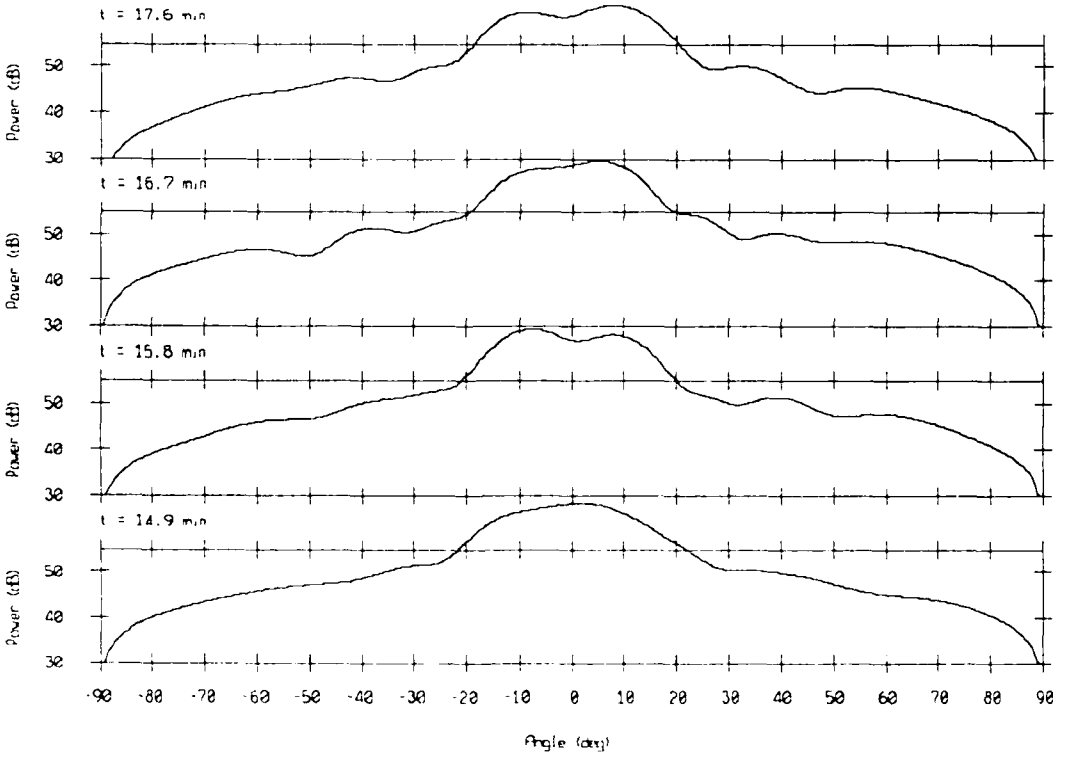

t = 13.9 min
t = 13.8 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.0 min
t = 8.4 min
t = 7.4 min
Power (dB)
50
40
30
90
80
70
60
50
40
30
20
10

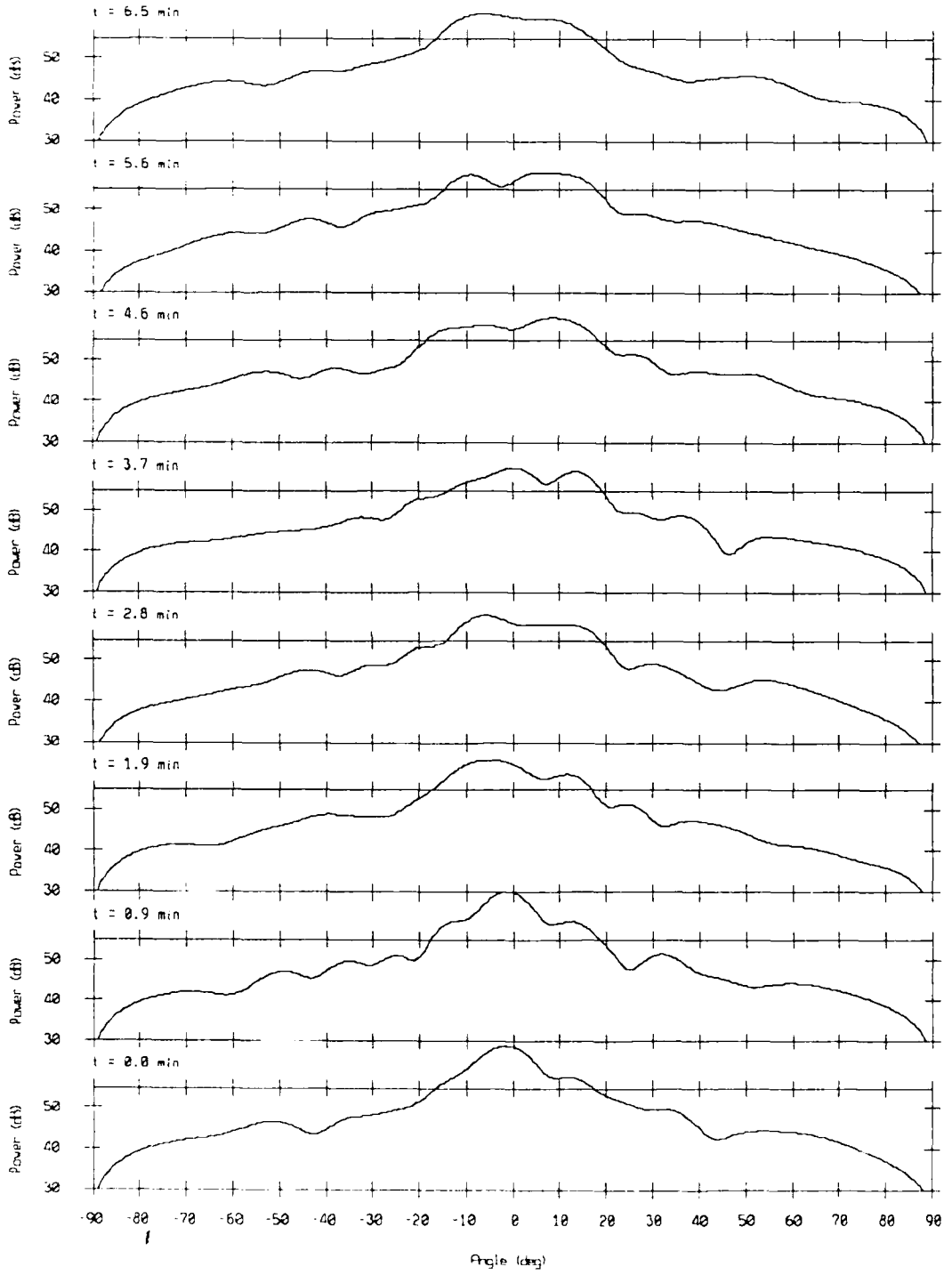
AD-A193 229 VERTICAL DIRECTIONALITY OF AMBIENT NOISE AT 32 DEG W AS 2/2
A FUNCTION OF LON (U) SCRIPPS INSTITUTION OF
OCEANOGRAPHY LA JOLLA CA MARINE PHYSIC
UNCLASSIFIED W S HODGKISS ET AL JAN 88 MPL-TM-387-D F/G 20/1 NL


1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
3·15
3·5
4·0
4·5

Array Response - 86247 Bin #4619

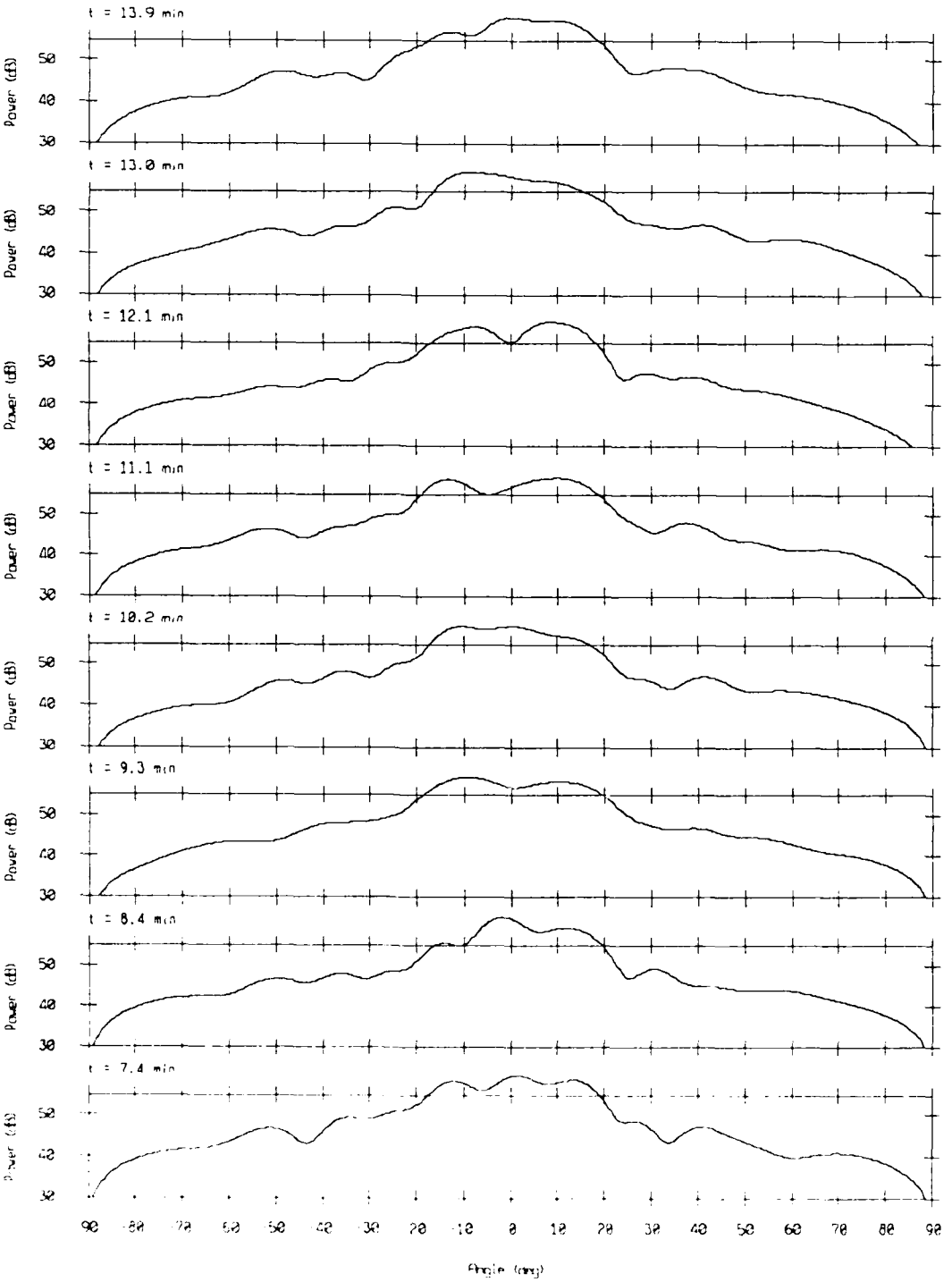
f = 75 Hz, rect window




Array Response - 86247 Bin #4793
f = 100 Hz, rect window
t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

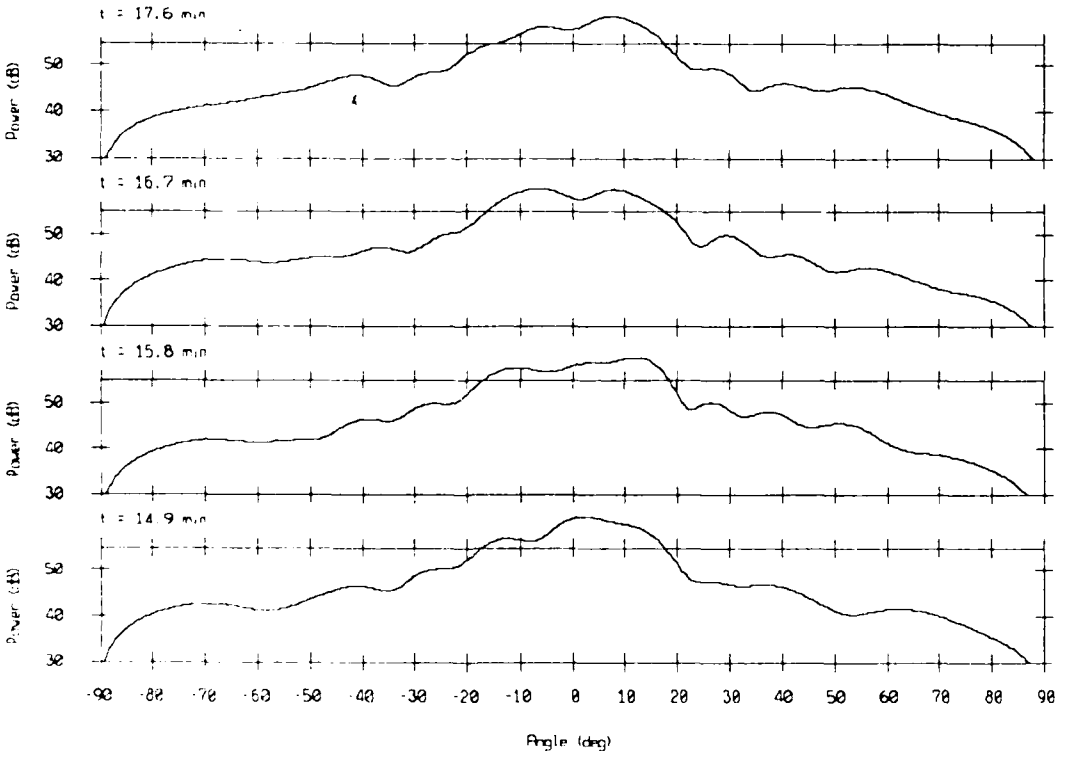
Array Response - 86247 Bin #4793

f = 100 Hz, rect window



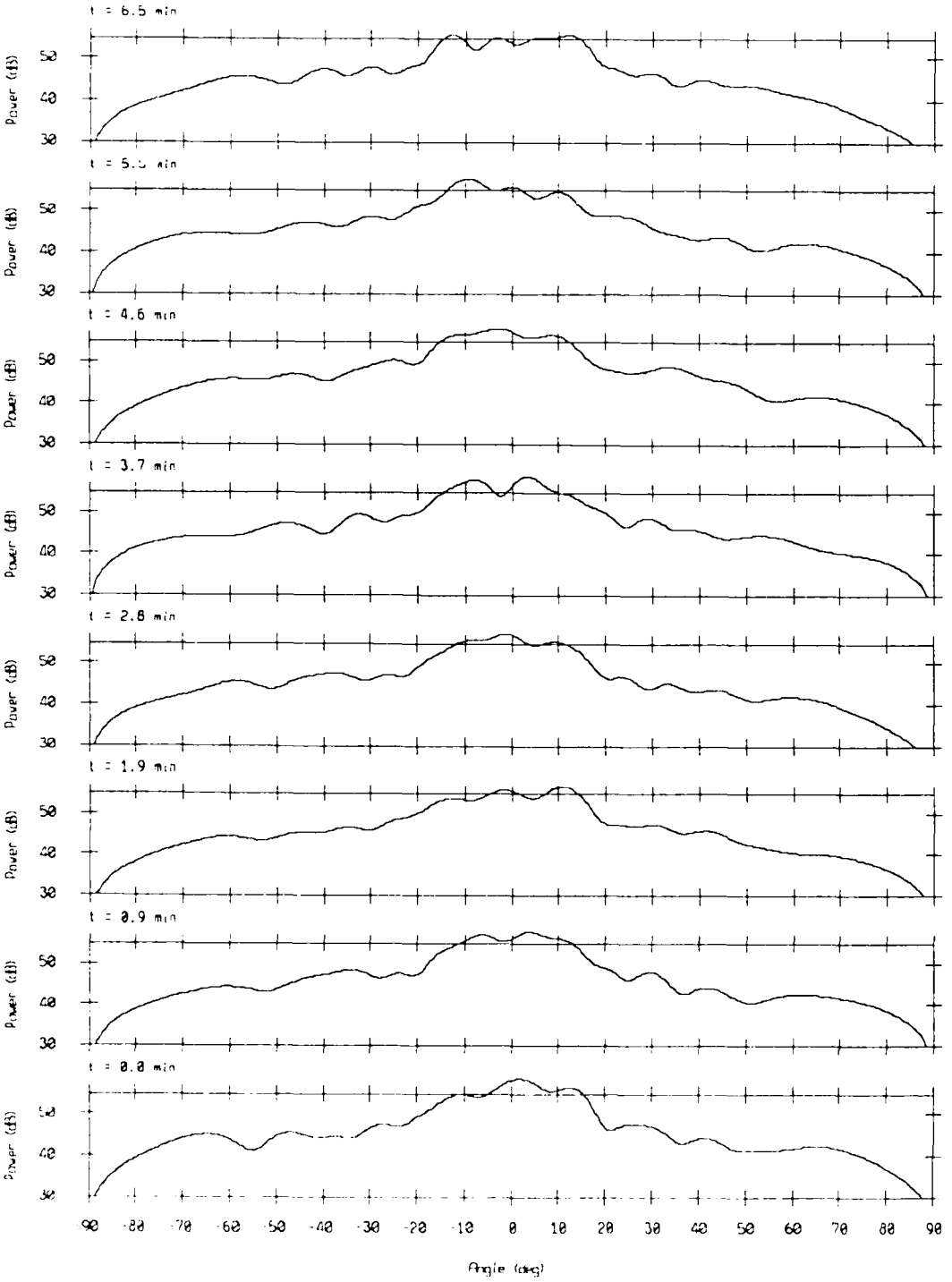
Array Response - 86247 Bin #4793

f = 100 Hz, rect window



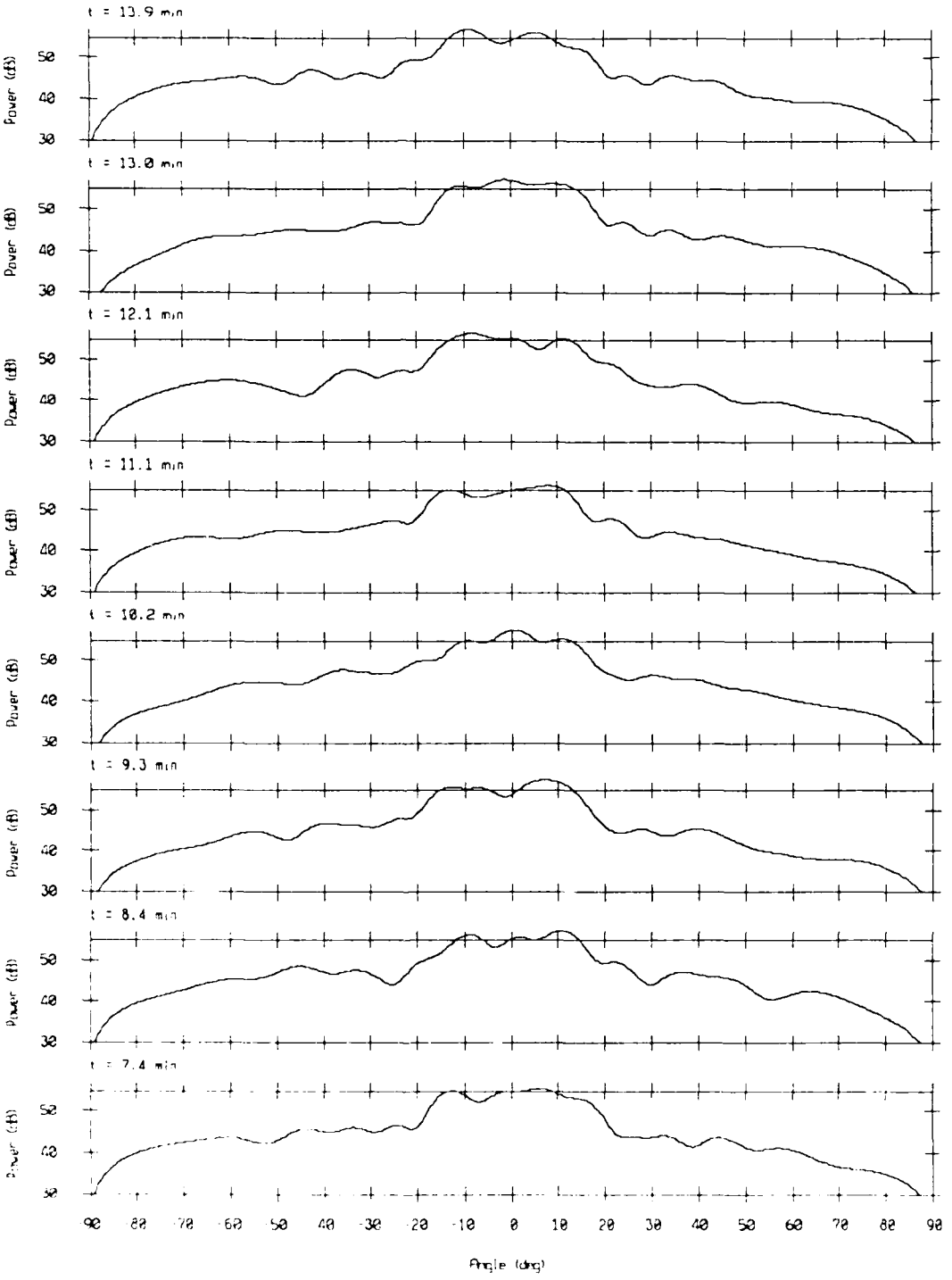
Array Response - 86247 Bin #4967

f = 125 Hz, rect window



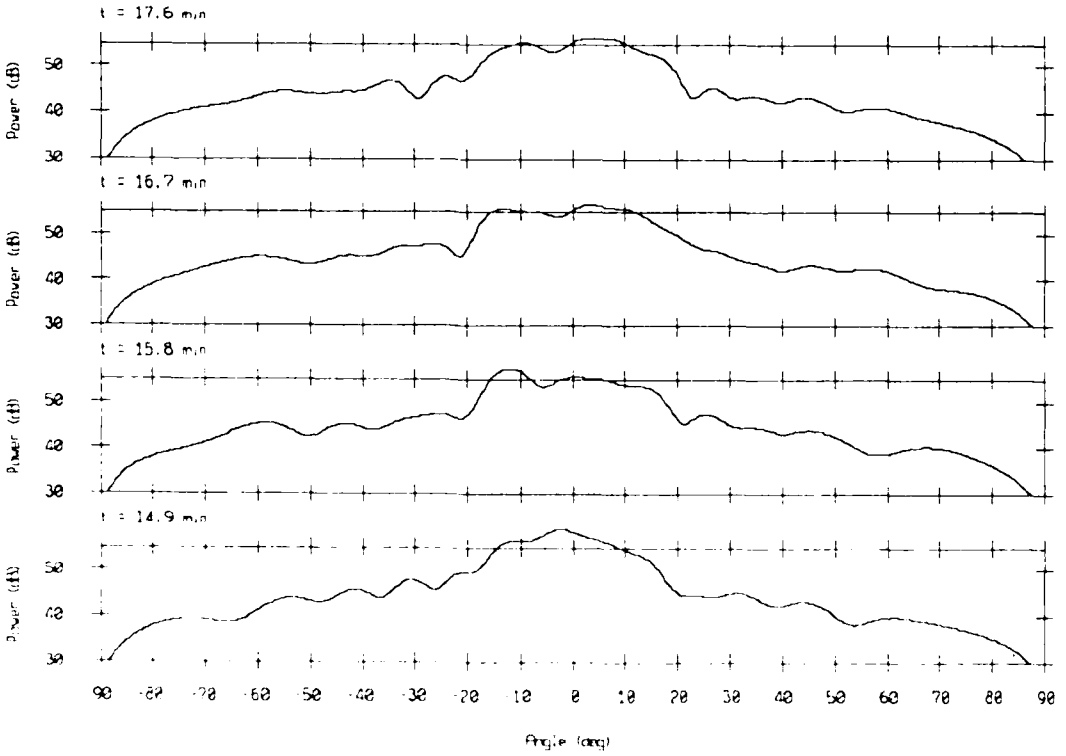
Array Response - 86247 Bin #4967

f = 125 Hz, rect window



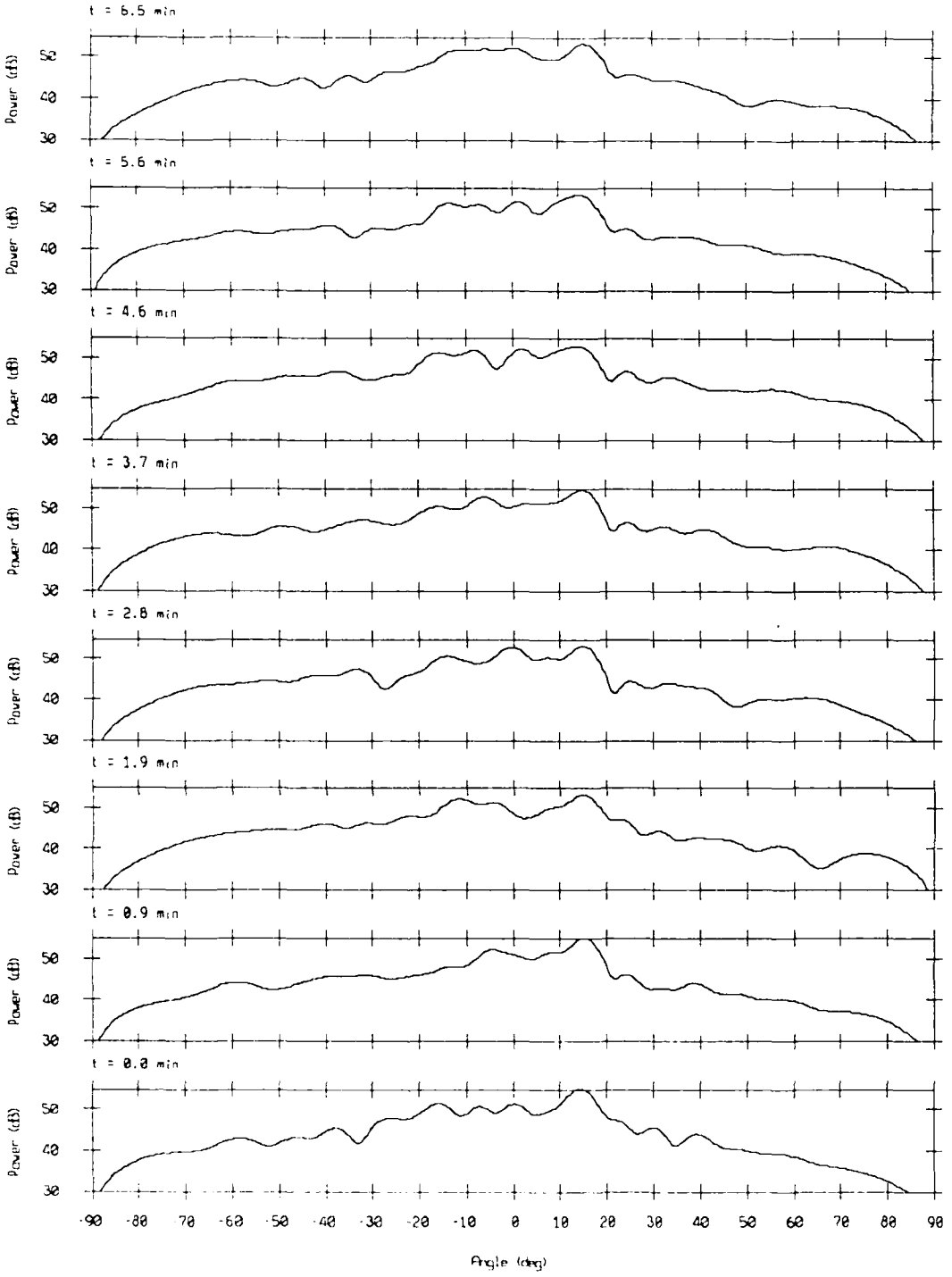
Array Response - 86247 Bin #4967

f = 125 Hz, rect window



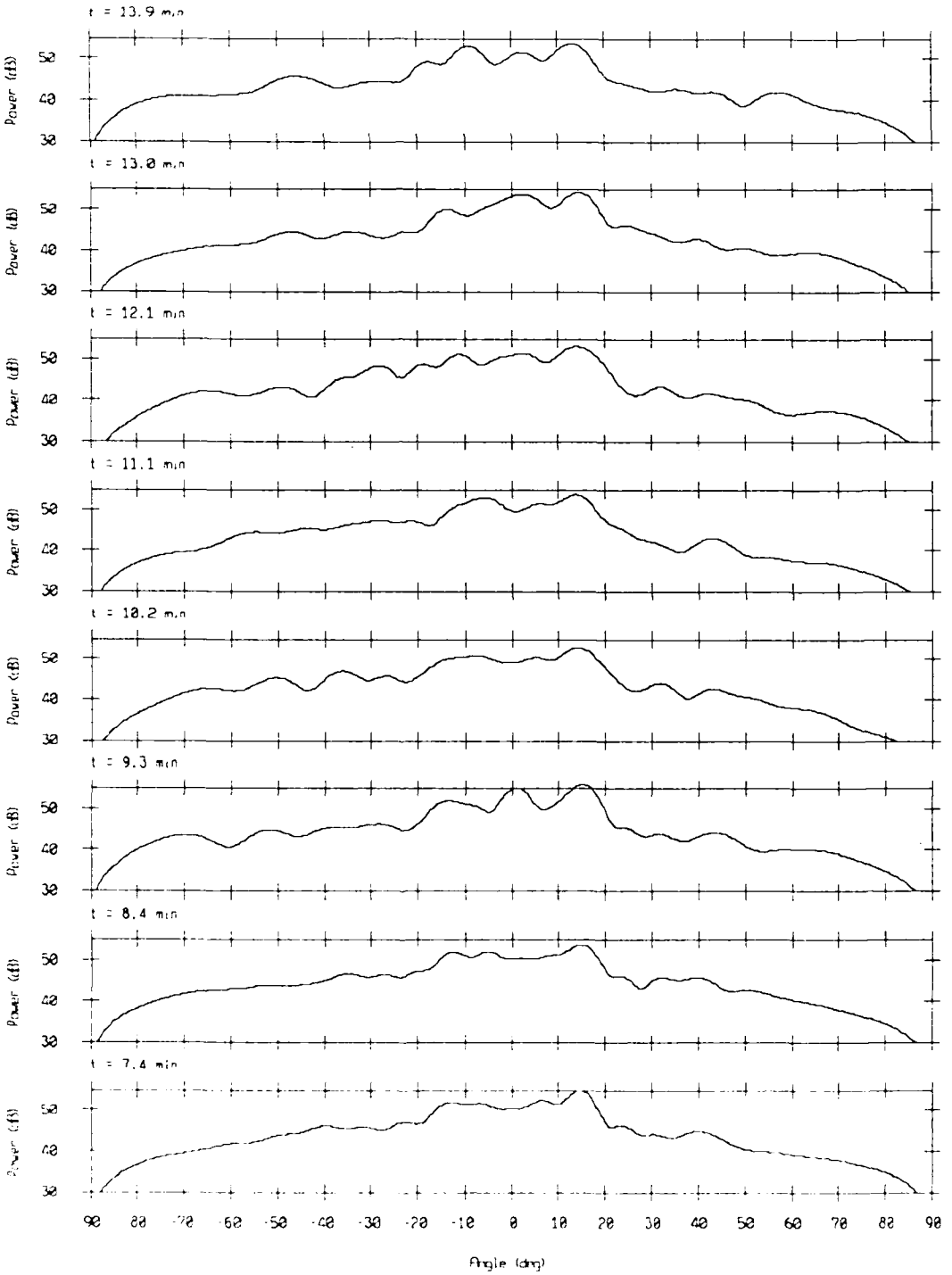
Array Response - 86247 Bin #5141

f = 150 Hz, rect window



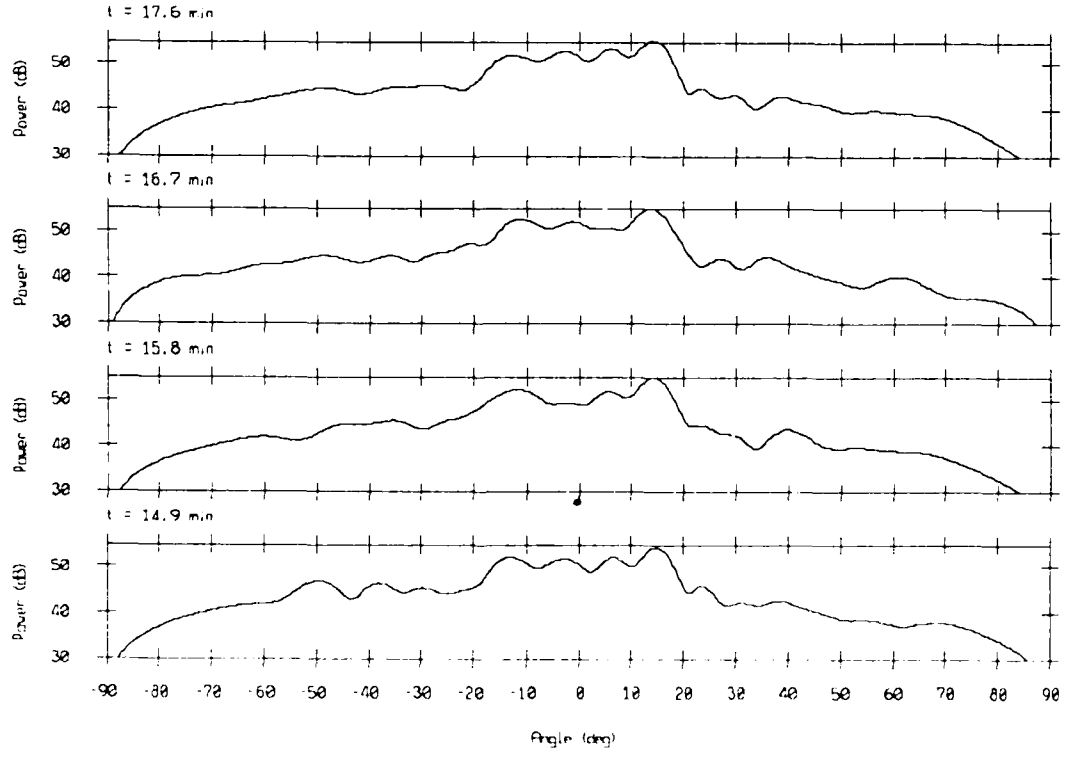
Array Response - 86247 Bin #5141

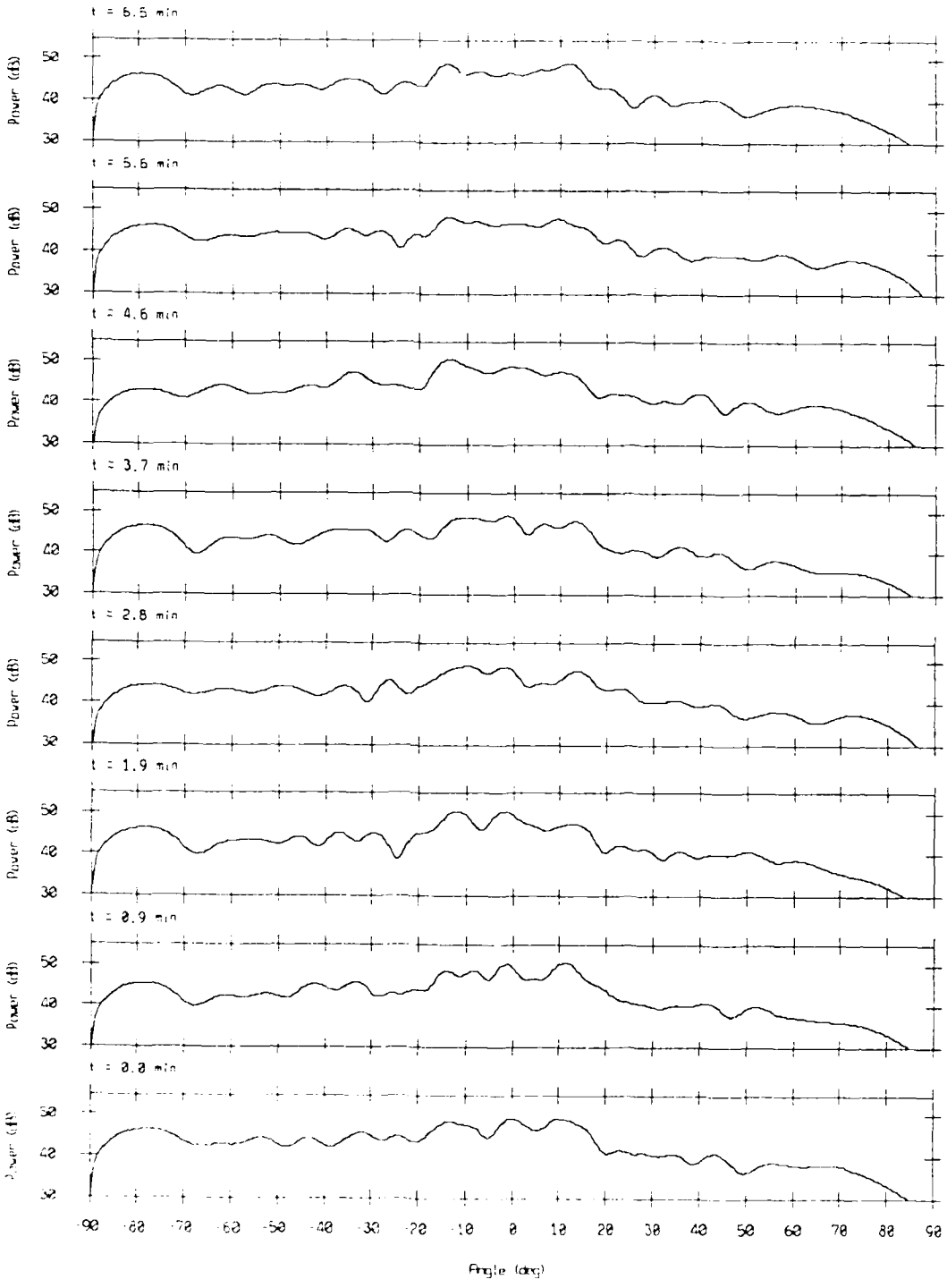
f = 150 Hz, rect window



Array Response - 86247 Bin #5141

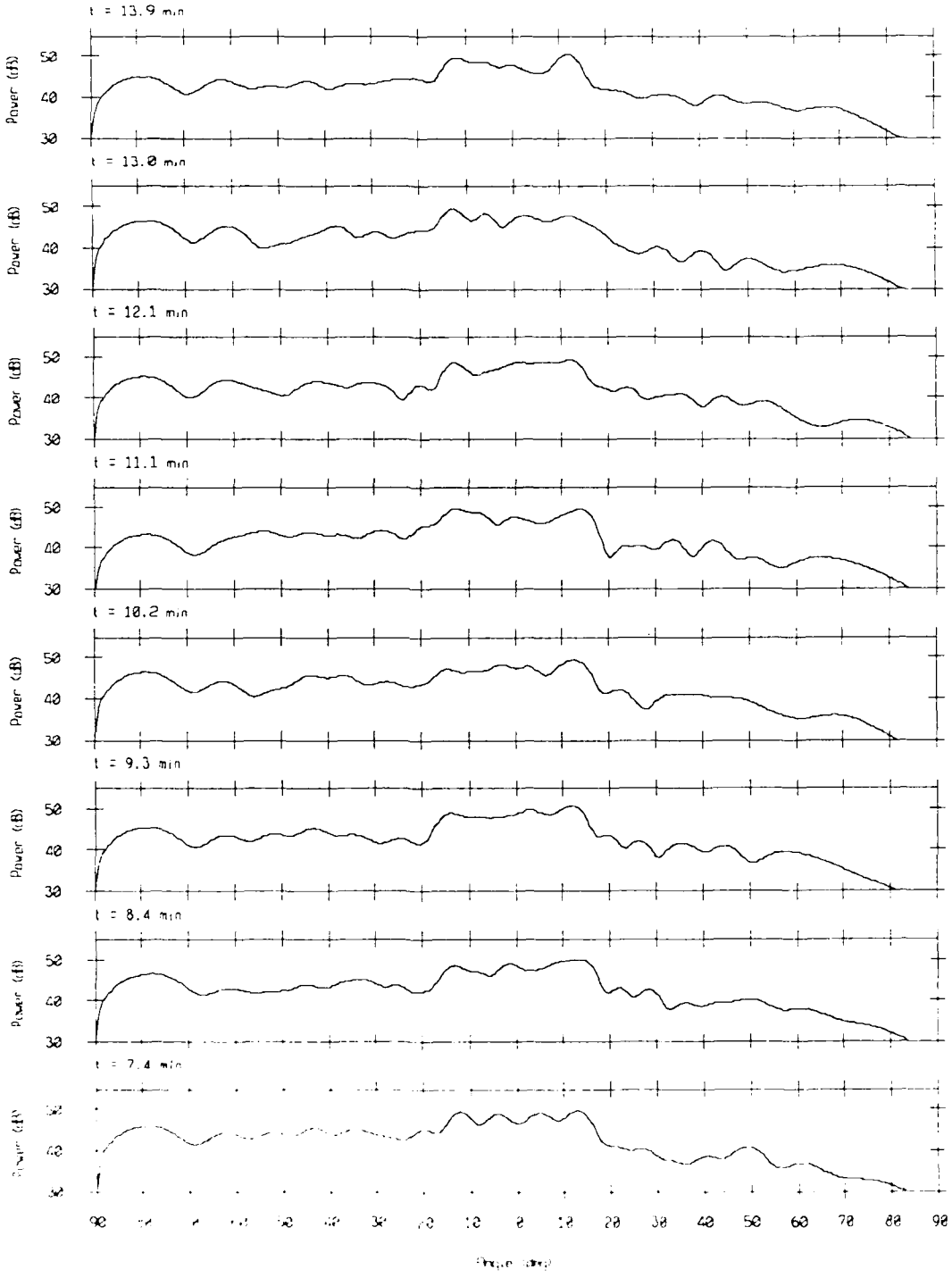
f = 150 Hz, rect window




Array Response - 86247 Bin #5316
f = 175 Hz, rect window
t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

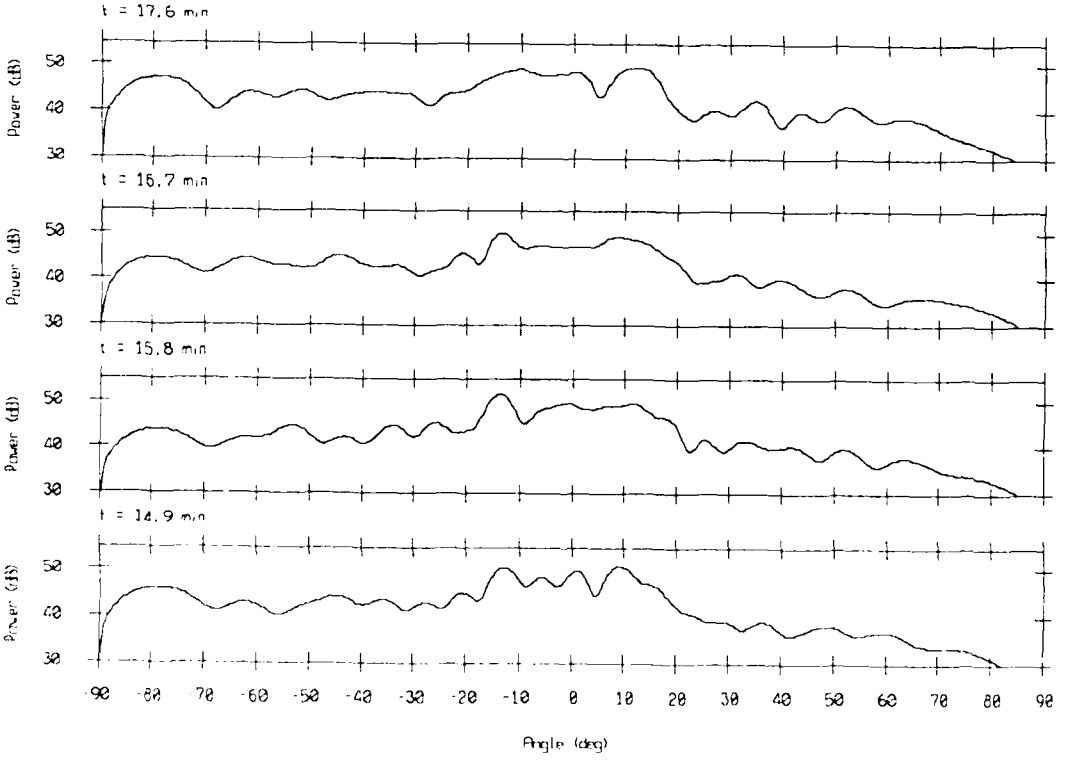
Array Response - 86247 Bin #5316

f = 175 Hz, rect window



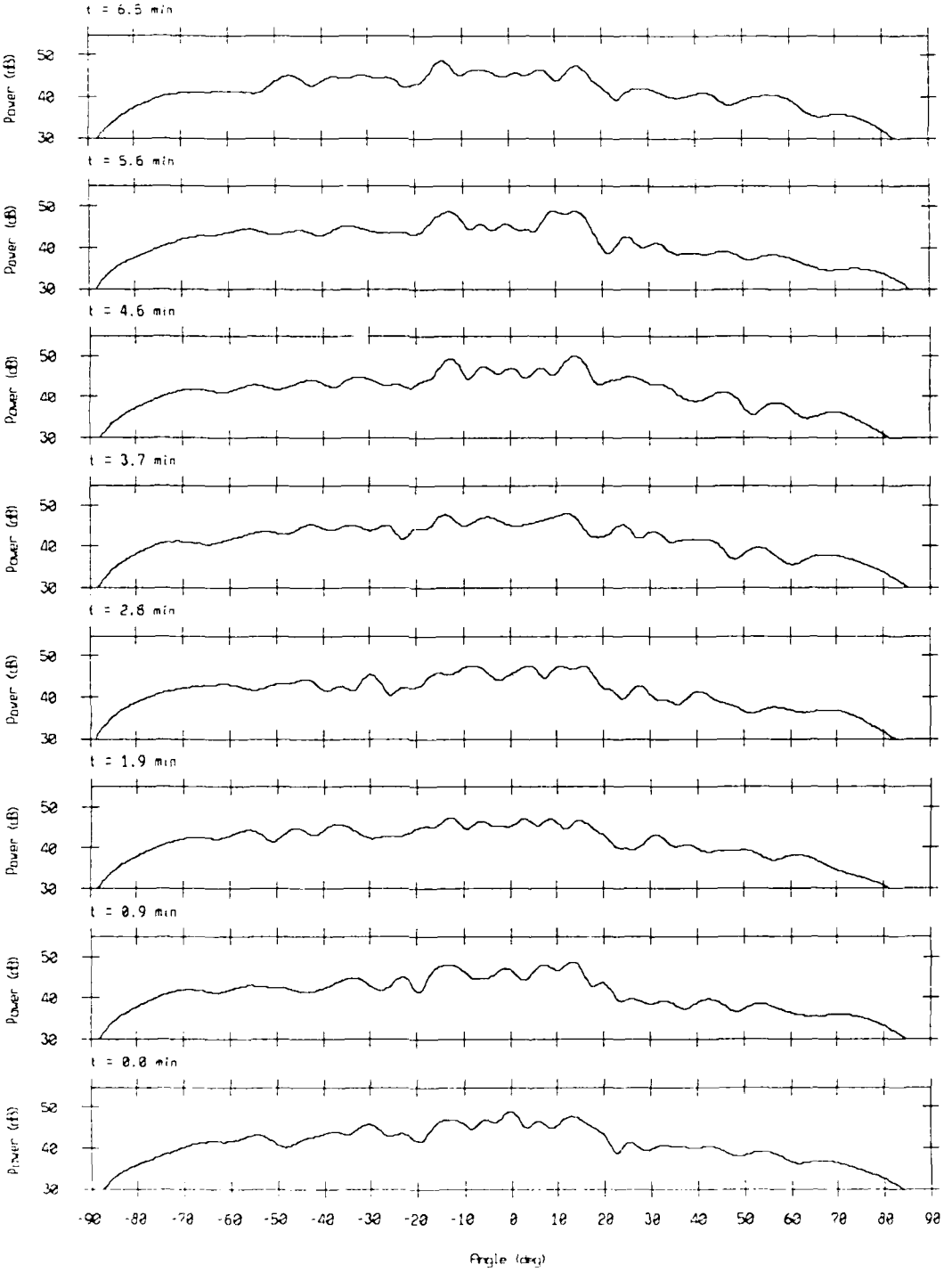
Array Response - 86247 Bin #5316

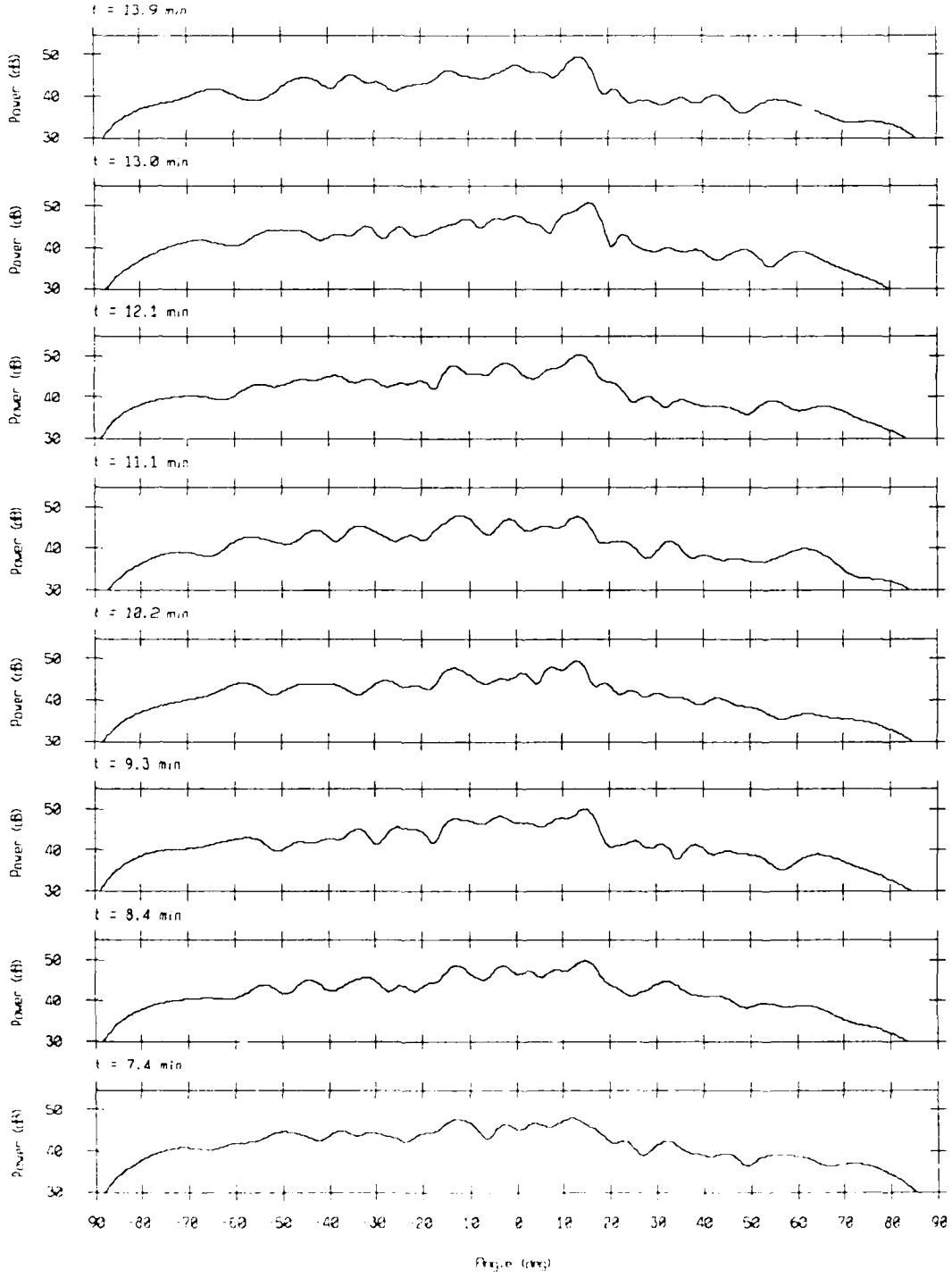
f = 175 Hz, rect window



Array Response - 86247 Bin #5490

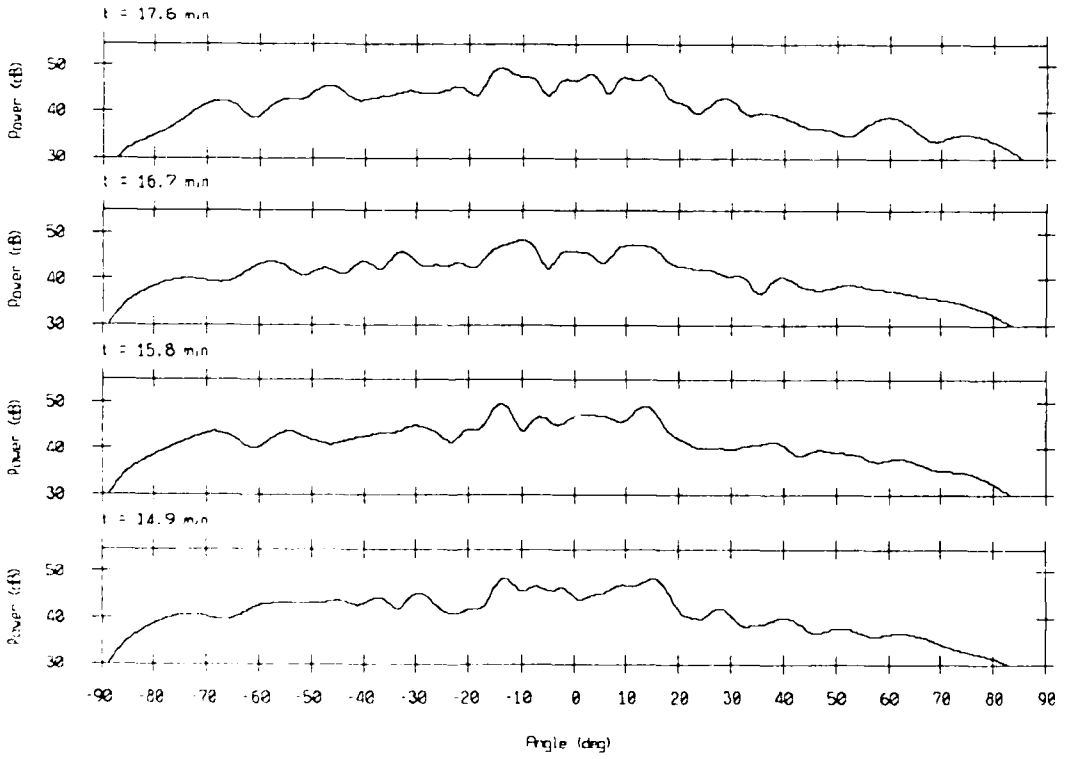
f = 200 Hz, rect window

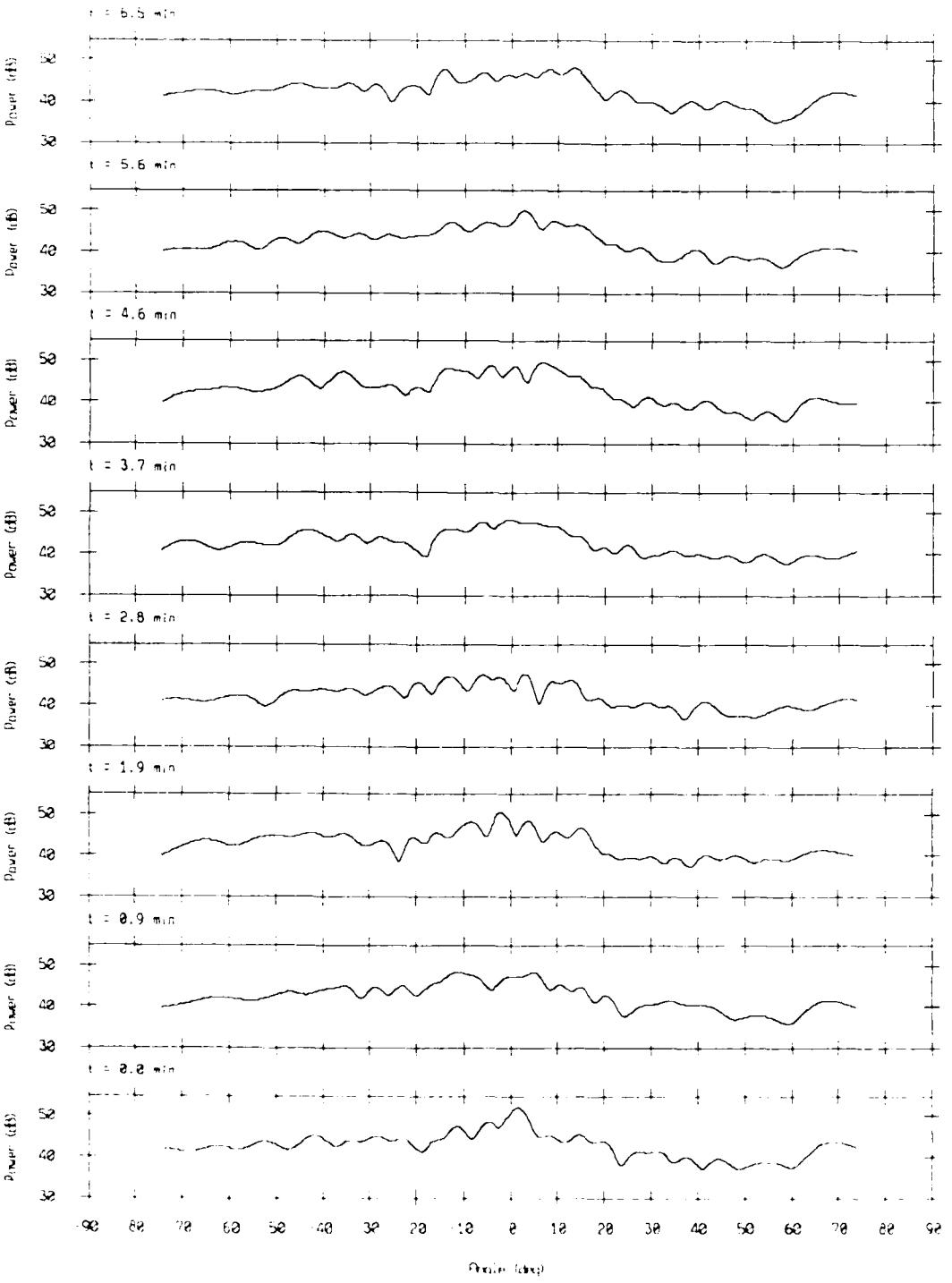


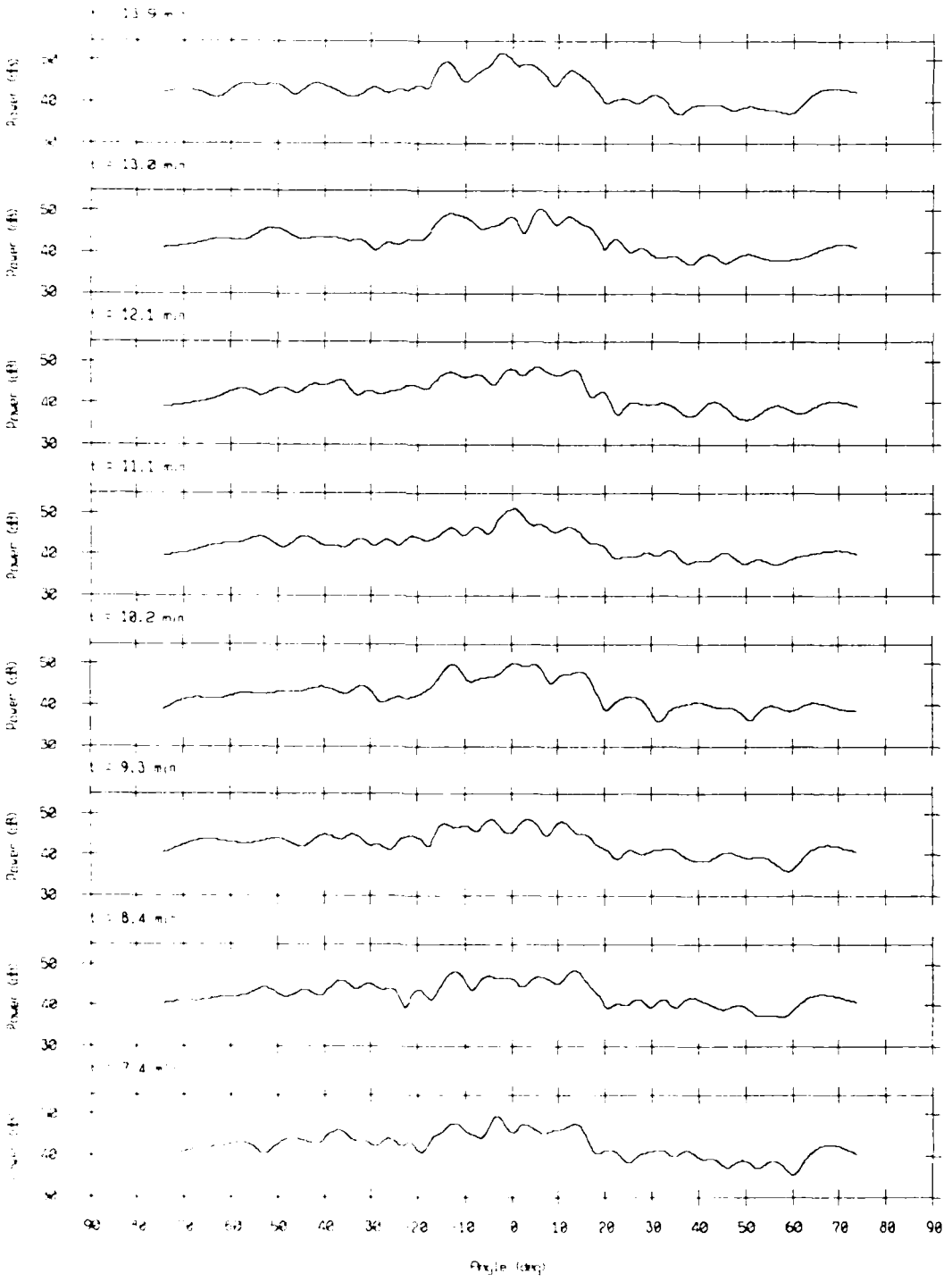

Array Response - 86247 Bin #5498
f = 200 Hz, rect window
t = 13.9 min
t = 13.0 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
50
40
30
90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90

Array Response - 86247 Bin #5490

f = 222 Hz, rect window

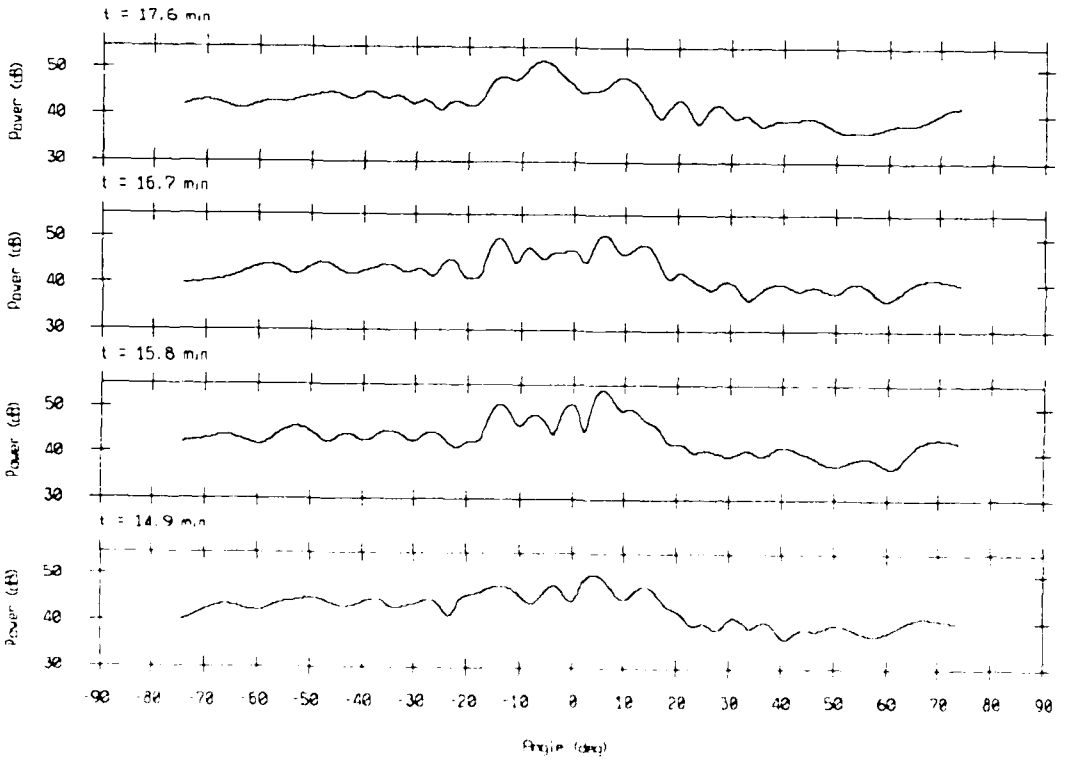


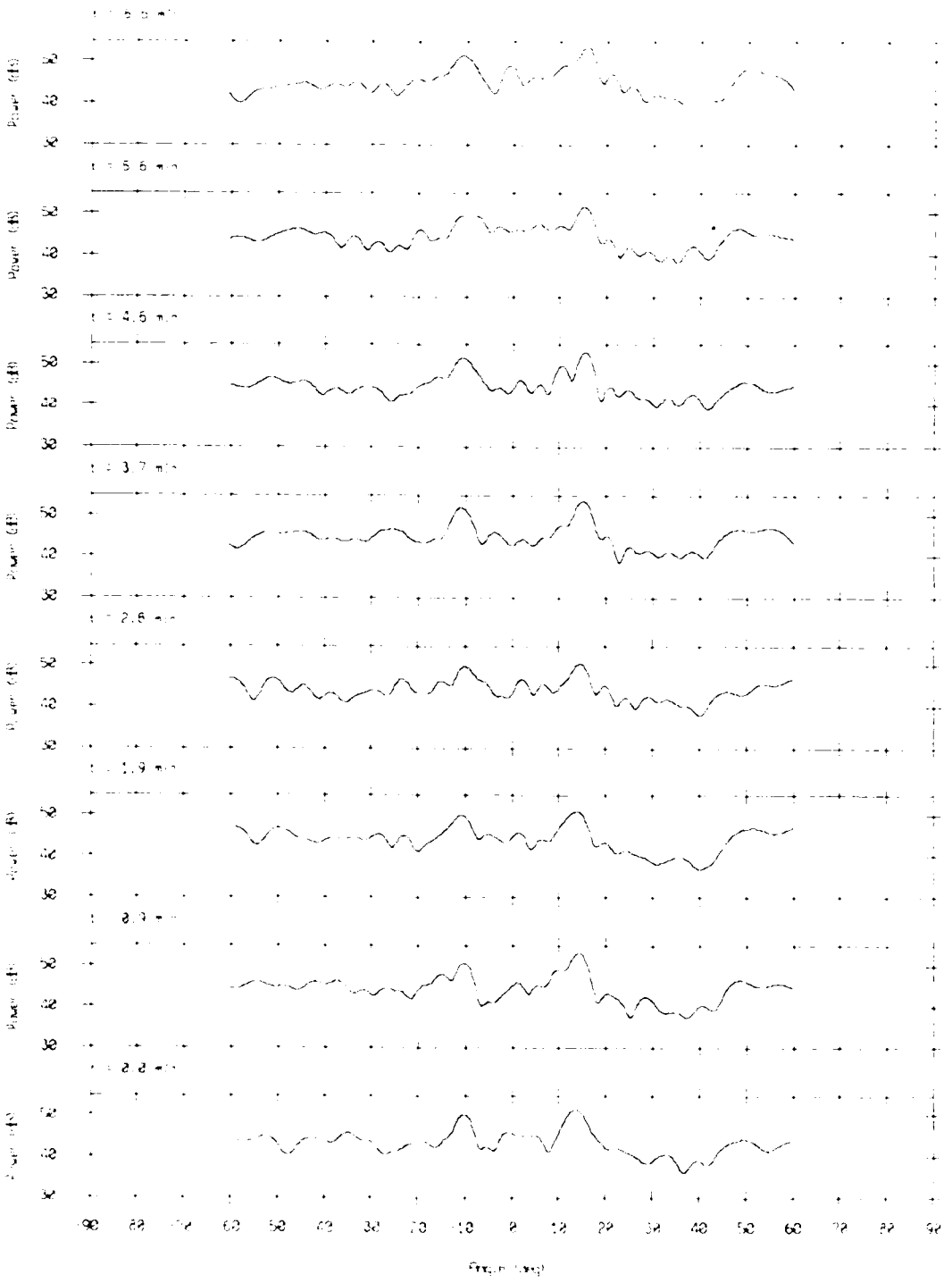

Array Response - 8624.7 Bin #3664
f = 225 Hz, rect window
t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90

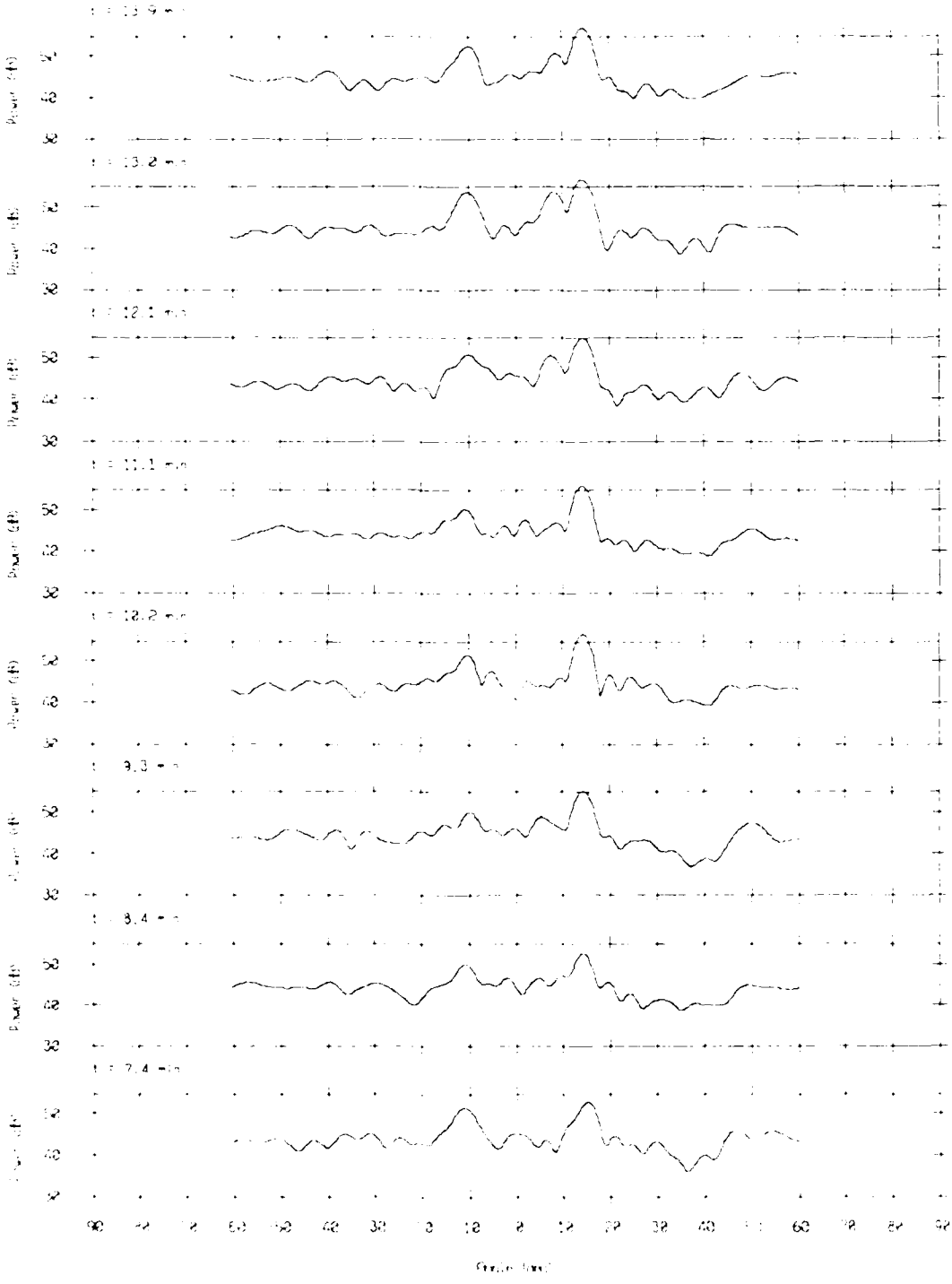

Array Response - 86247 Bin #5664
f = 225 Hz, rect window
t = 13.9 min
t = 13.0 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
Power (dB)
50
40
30
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
Angle (deg)

Array Response - 86247 Bin #5664

f = 225 Hz, rect window

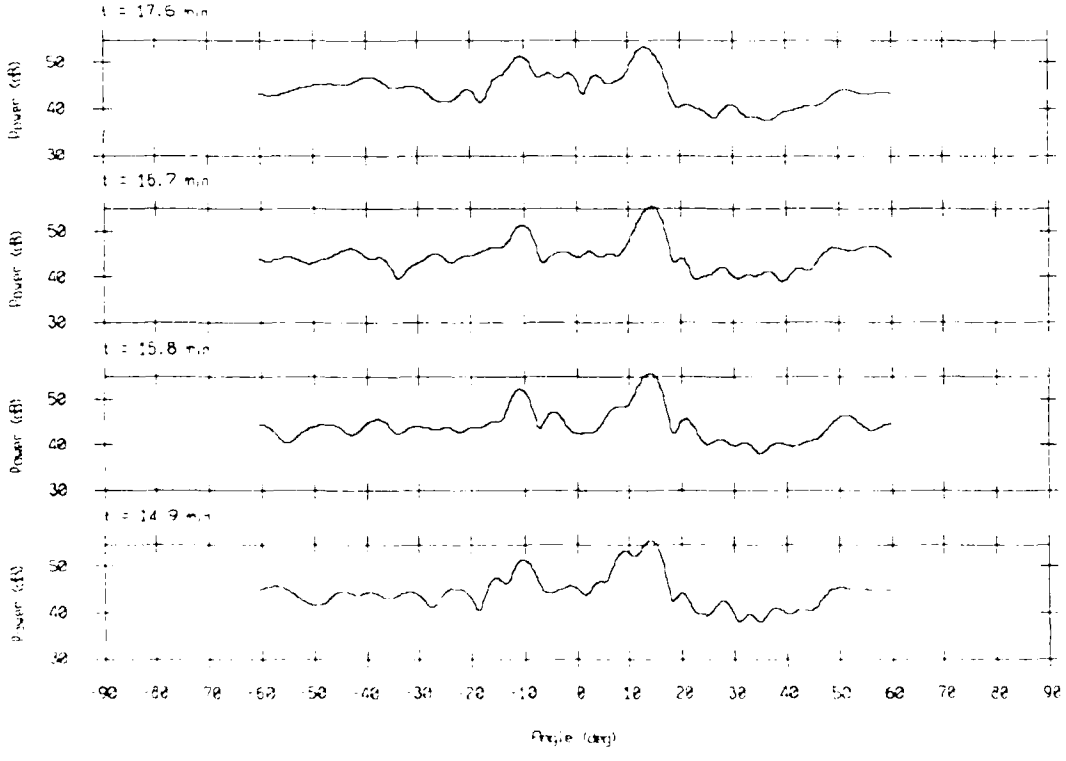






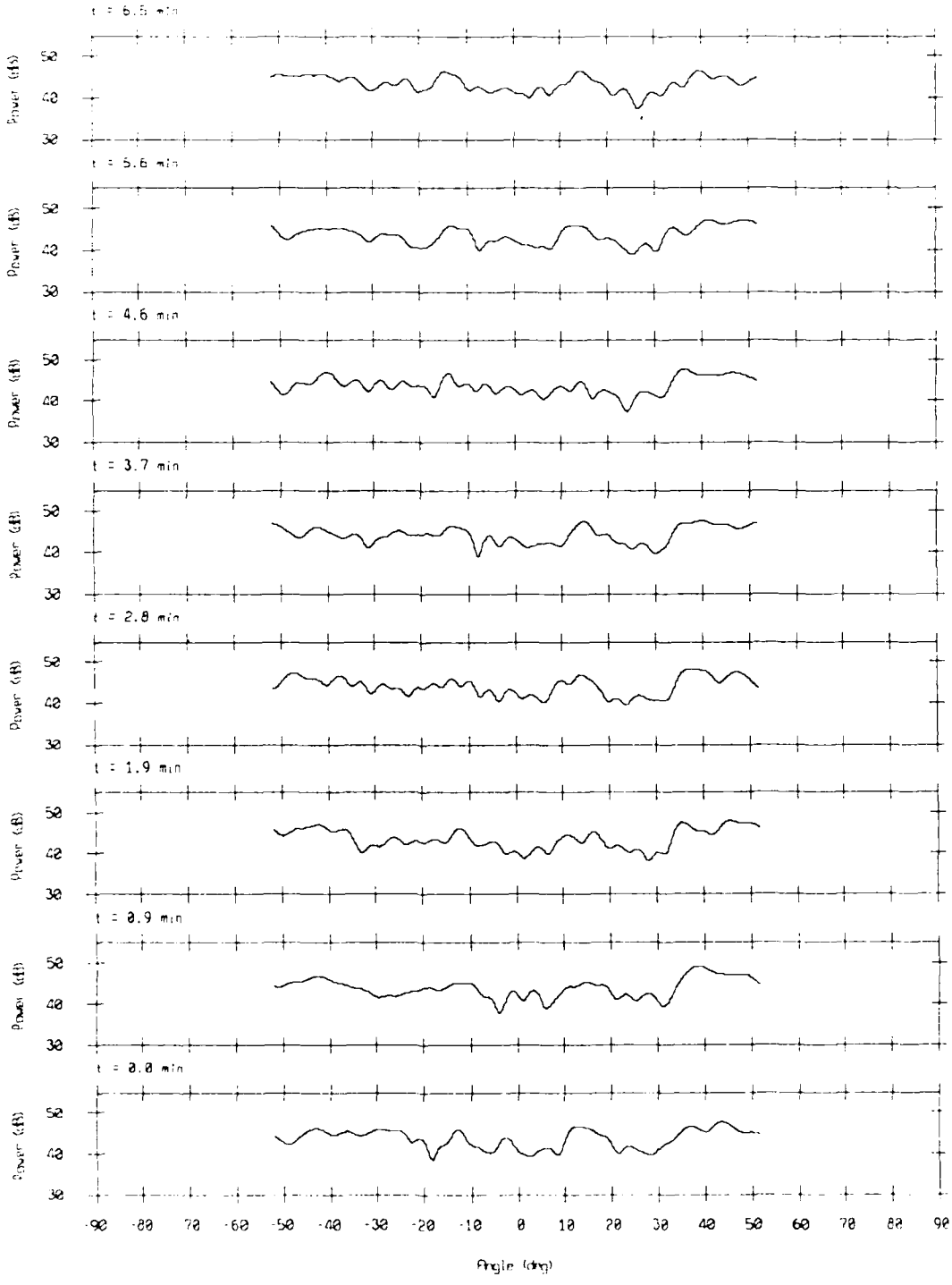
Array Response - 86247 Bin #5832

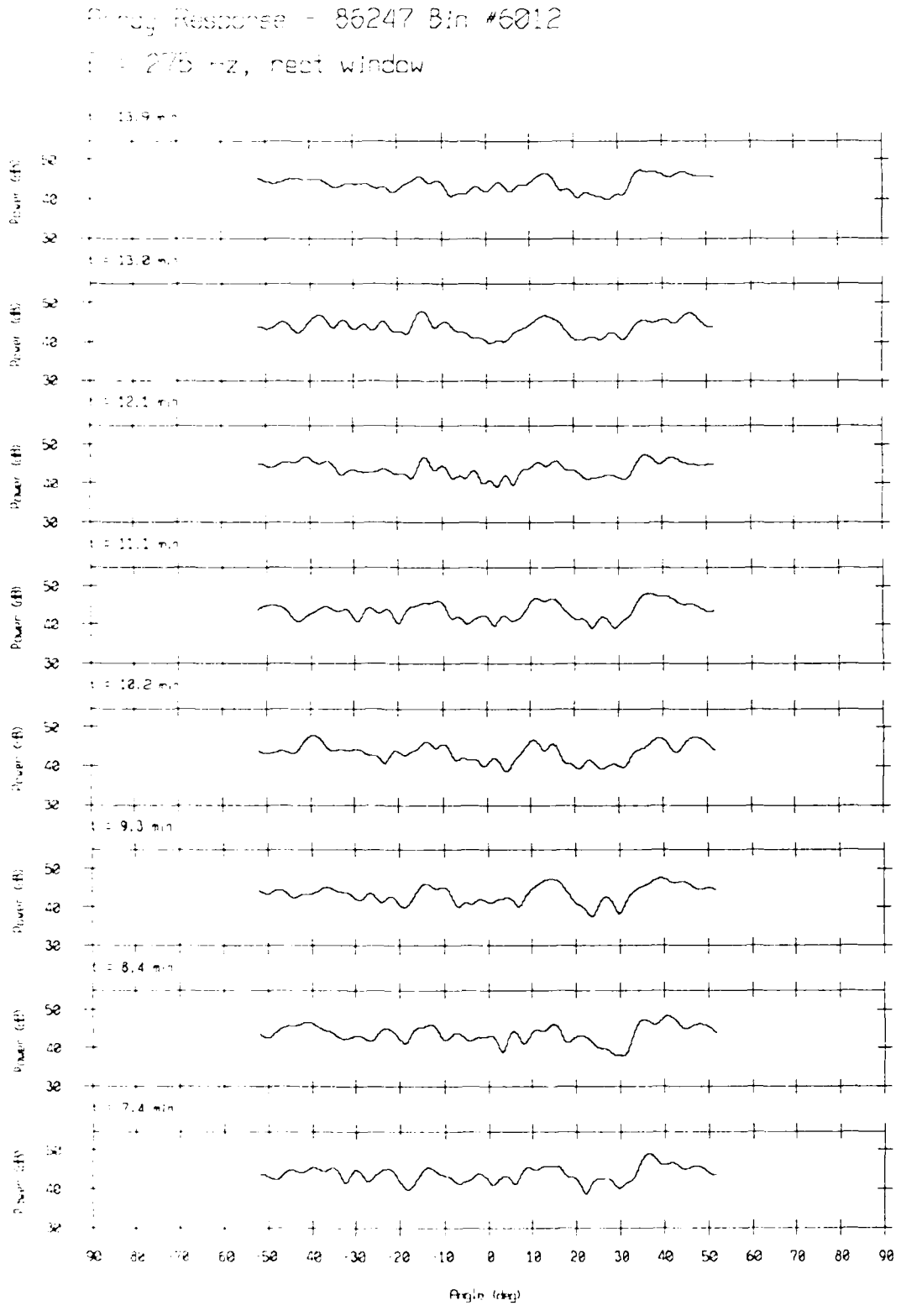
f = 252 Hz, rect window



Array Response - 86247 Bin #6812

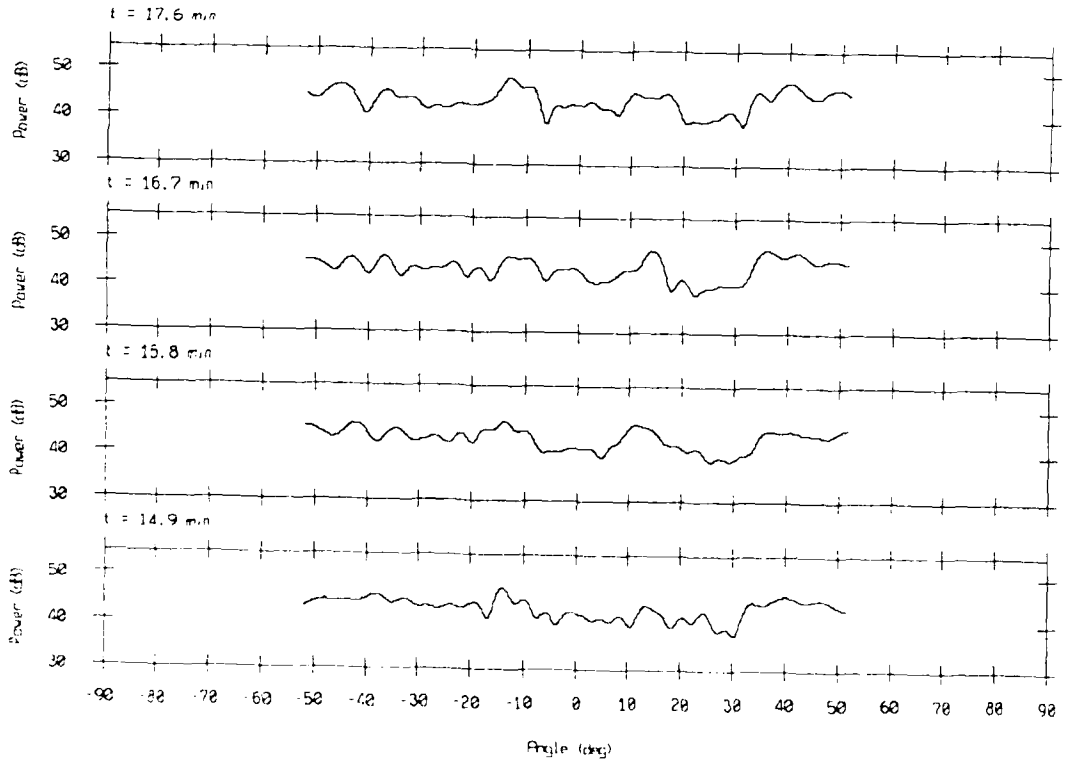
f = 275 Hz, rect window

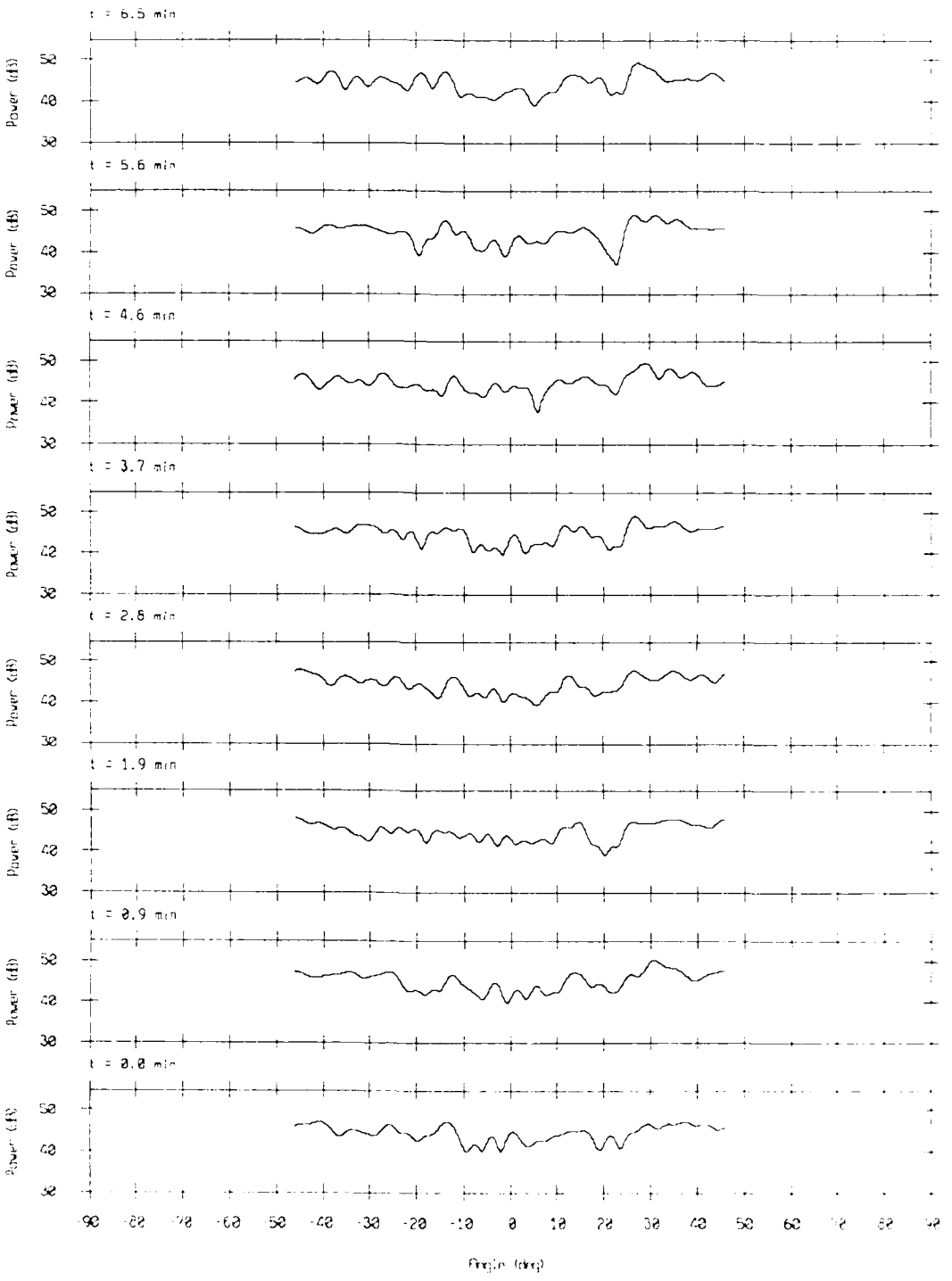


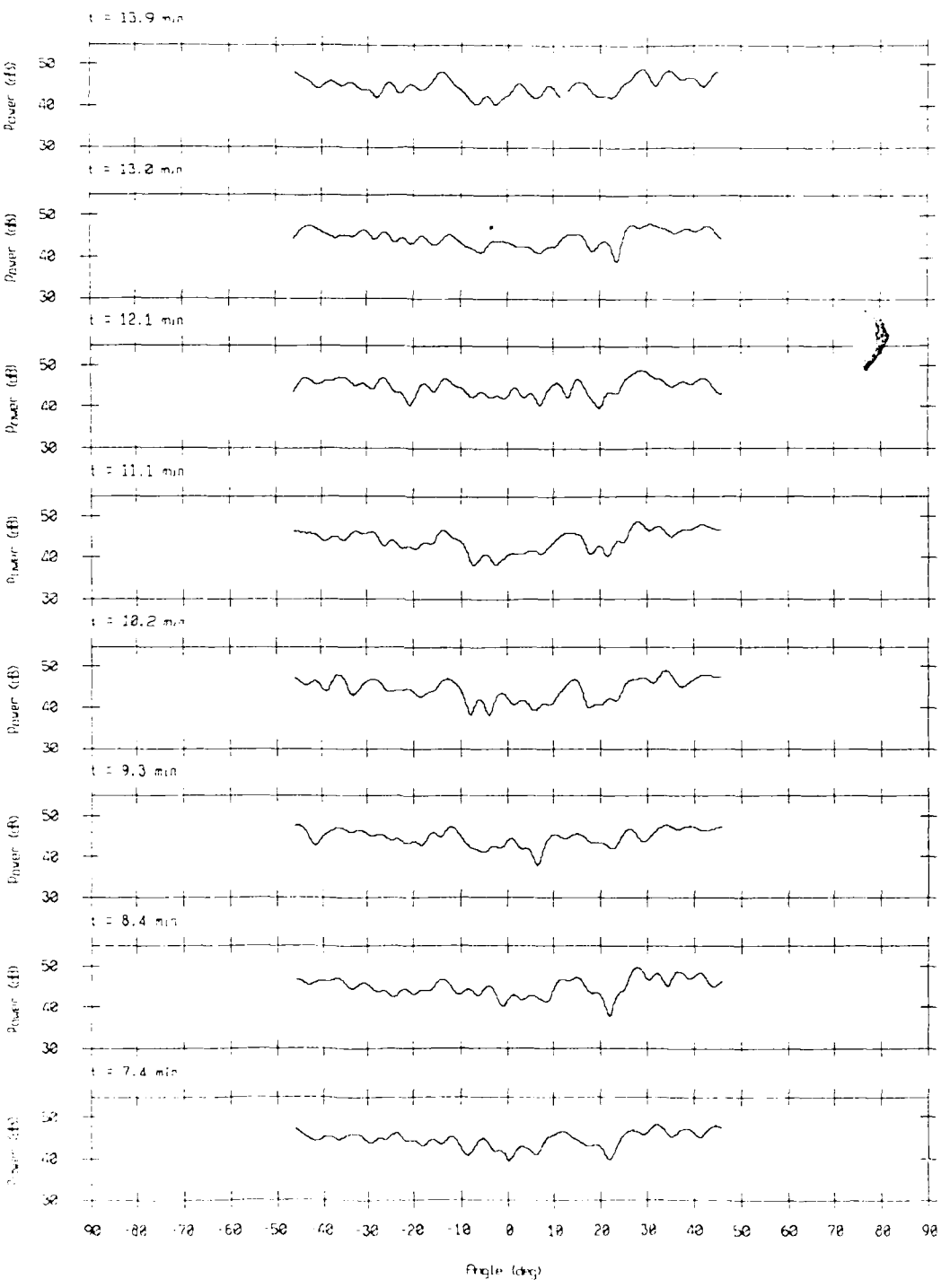

Array Response - 86247 Bin #6012
f = 275 Hz, rect window
t = 13.9 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

Array Response - 86247 Bin #6012

f = 275 Hz, rect window

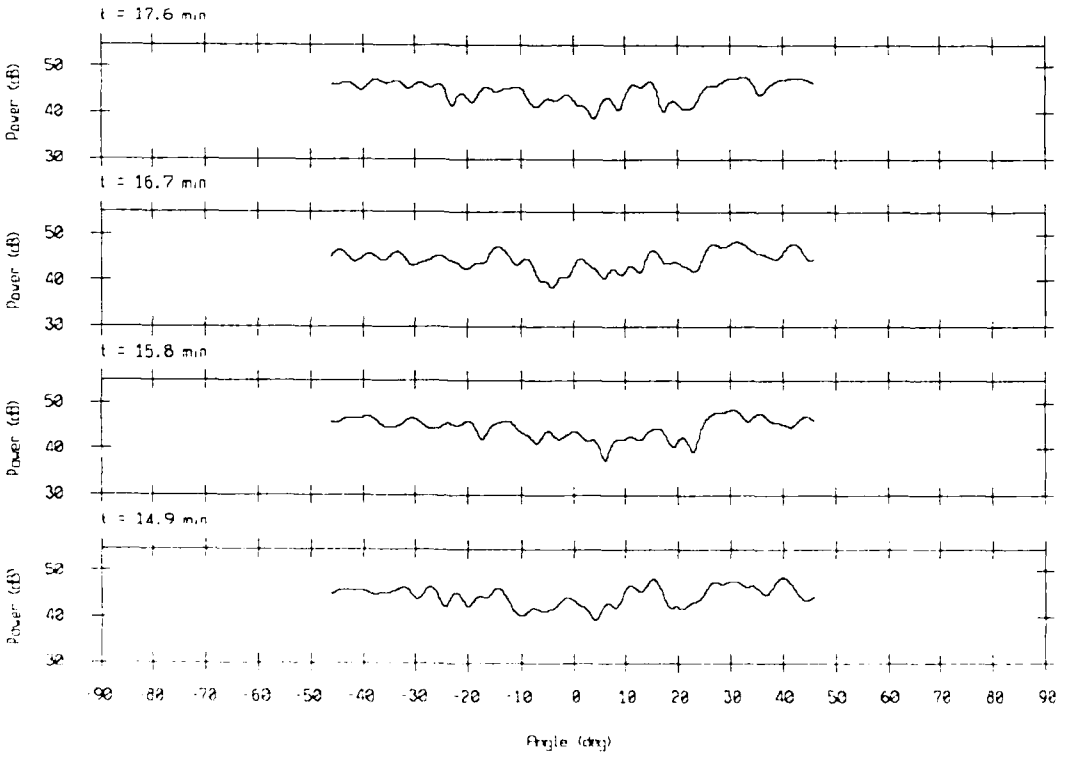



Array Response - 86247 Bin #6186
f = 302 Hz, rect window
t = 6.5 min
t = 5.6 min
t = 4.6 min
t = 3.7 min
t = 2.8 min
t = 1.9 min
t = 0.9 min
t = 0.0 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)


Array Response - 86247 Bin #6186
f = 322 Hz, rect window
t = 13.9 min
t = 13.2 min
t = 12.1 min
t = 11.1 min
t = 10.2 min
t = 9.3 min
t = 8.4 min
t = 7.4 min
Power (dB)
50
40
30
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Angle (deg)

Array Response - 86247 Bin #6186

f = 300 Hz, rect window



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